United States Department of Agriculture

Natural Resources Conservation Service
In cooperation with Texas Agricultural Experiment Station

Soil Survey of McLennan County, Texas

How to Use This Soil Survey

General Soil Map

The general soil map, which is a color map, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

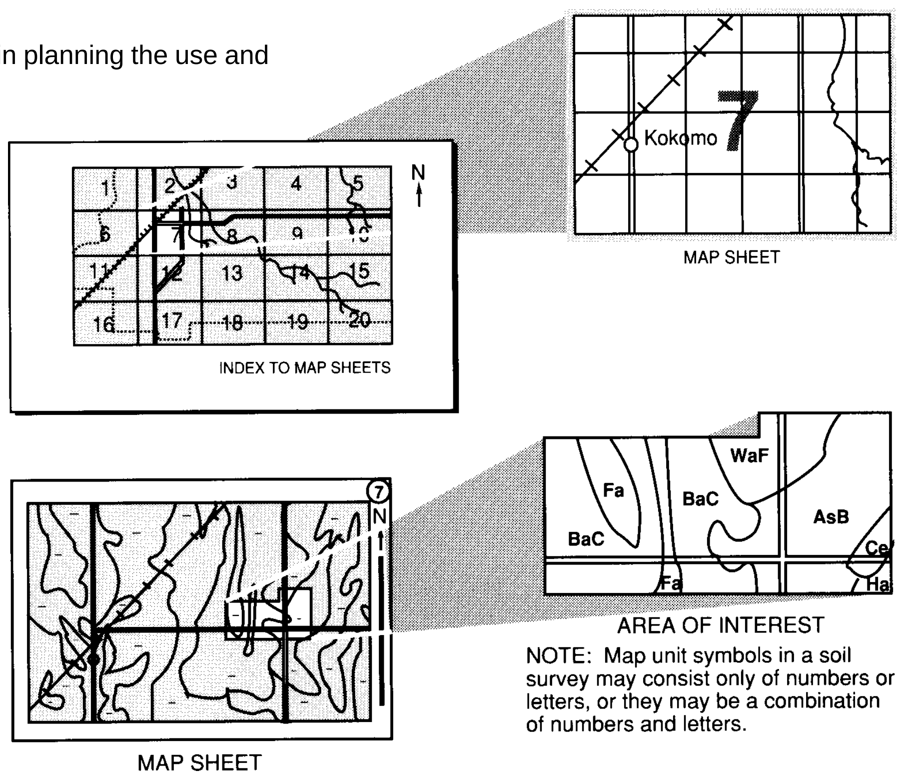
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.



This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1990. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service and the Texas Agricultural Experiment Station. The survey is part of the technical assistance furnished to the McLennan County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Rock outcrop of the Austin Chalk geologic formation overlooking a recreational area along the Brazos River.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

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Foreword

This soil survey contains information that affects land use planning in this survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

John P. Burt
State Conservationist
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Soil Survey of McLennan County, Texas

By Glen B. Miller and James M. Greenwade, Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
Texas Agricultural Experiment Station

McLennan County is in the central part of Texas (fig. 1). The total area, which includes water areas, is 679,162 acres, or 1,061 square miles. The county is rectangular. It is about 38 miles long and 27 miles wide. Elevation ranges from about 900 feet above sea level in the northwestern part of the county to about 350 feet above sea level in an area along the Brazos River in the south-central part of the county. The topography generally is undulating or gently sloping in the northern and western parts of the county and gently sloping in the eastern and southern parts.

McLennan County is in the Grand Prairie and Texas Blackland Prairie Major Land Resource Areas *(19)*. Most of the soils formed under prairie vegetation and are dark colored clays, silty clays, or clay loams. In some areas on terraces along the Brazos River, the soils formed under post oak-savannah vegetation. These soils are mostly light colored sandy loams or loamy fine sands.

The county is drained by numerous creeks and streams that flow into the Brazos and Bosque Rivers, which flow through the county.

This soil survey updates the survey of McLennan County published in 1958 *(16)*. It provides additional information and has larger maps, which show the soils in greater detail. It also provides greater detail than the 1905 publication entitled “Soil Survey of the Waco Area, Texas,” which includes parts of McLennan and Bosque Counties *(9)*.

General Nature of the Survey Area

This section gives general information about McLennan County. It describes history and settlement, natural resources, agriculture, and climate.

History and Settlement

O.T. Hayward, Professor of Geology, Baylor University, prepared this section.

The history of McLennan County appears to have four distinctive eras. The first of these is the period before European settlement, extending back to the first arrival of primitive nomadic hunters in central Texas. The second is the era of the earliest exploration, when various nations and groups attempted to exert their territorial claims on the land in the survey area. The third era is the period of settlement, when people who came to the wilderness of central Texas established homes. The fourth era is the period of historic maturity, which continues today. This is the period of major urban and industrial development. The four eras are described in the paragraphs that follow.

The Period Before European Settlement

The earliest evidence of human occupation in central Texas is in the form of rare and distinctive dart points, called Clovis Points. The people who made the Clovis Points were probably the first humans to see this part of Texas. They were in the area from about 11,500 to 8,500 years ago *(8)*. The survey area was later occupied by a continuously changing group of cultures, mostly from the north and northwest and mostly hunters and gatherers *(11)*. By the time that the Europeans arrived, the area was roughly divided among three tribal groups. The Tonkawas occupied the Grand Prairie areas on the west. The Wacos lived along the Brazos River and Whiterock Escarpment in the central part of the survey area. The Tawakoni occupied the Texas Blackland Prairie areas and woodlands to the east *(12)*. All of these tribal groups were eventually

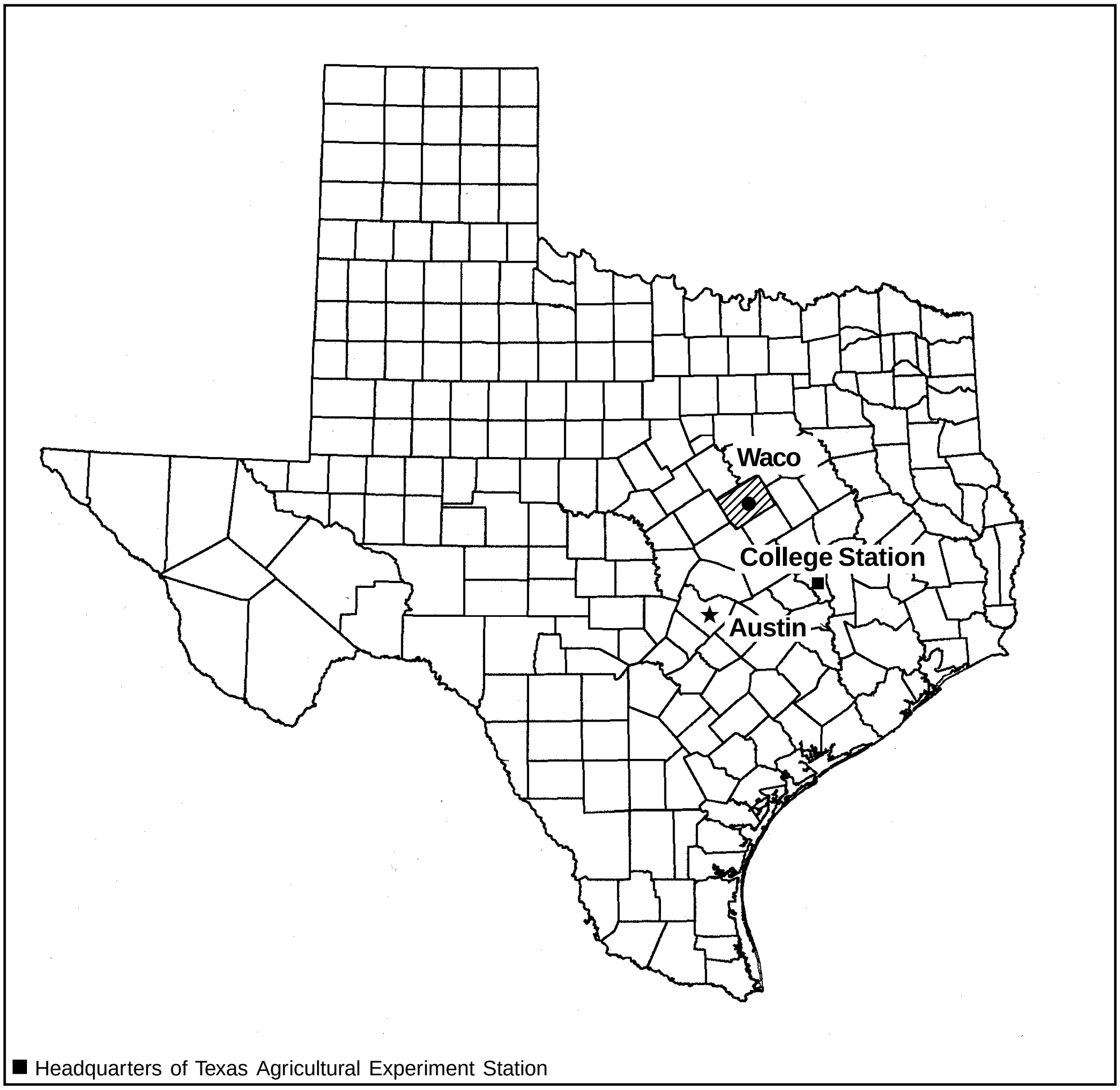

Figure 1.—Location of McLennan County, in Texas.

driven from the land by the advancing wave of settlement. By the 1800's, they were largely gone, though the last remaining Tonkawas were not removed to their Oklahoma reservation until 1944 *(6)*.

Earliest Exploration

The Spaniards were probably the first Europeans to reach McLennan County *(4, 13)*. In 1687, a Frenchman named Robert Cavelier Sieur de La Salle and 17 of his men left the French Fort St. Louis on the Gulf Coast in an attempt to return to Illinois *(3)*. While the French probably never entered central Texas, their appearance on the scene and their eventual expulsion of the Spanish from east Texas in 1719 drove the Spanish to take action to protect their fading empire. In 1721, the Aguayo expedition, launched to reestablish Spain's claim to Texas, passed through what is now the southern part of Waco on its way to east Texas. In this action, Aguayo and his expeditionary force became the first Europeans to see central Texas. As a result of the expedition, Spain firmly established its claim to Texas *(6, 24)*.

The first Americans to enter McLennan County were probably Philip Nolan and a group of his companions, who entered Texas from Louisiana in 1800 to hunt wild horses and perhaps also to attempt to tear Texas away from Spanish control. Spanish troops found the Americans somewhere in the vicinity of McLennan

County. Nolan died in the ensuing engagement. The remainder of the men became prisoners of the Spanish Government in Mexico *(12, 25)*.

Settlement

In 1832, Thomas Jefferson Chambers became the first surveyor of the Mexican land grant where Waco now stands. A number of other Mexican grants (awarded along the Brazos River at about the same time) established a survey system essential to permanent settlement of the survey area. In 1844, Barnard's trading post was built along a tributary of Tehuacana Creek a few miles east of Waco, and George Barnard became the first white settler in the survey area *(6)*. In the following year, Neil McLennan established a home near the junction of the South Bosque River and Hog Creek, thus becoming the first settler west of the Brazos River *(6, 12)*. The first settlers were subsistence farmers, growing corn and garden vegetables, hunting wild game, and running a few cattle on the rich, open range. Neil McLennan's "M" was the first brand to be registered in McLennan County. His cattle grazed along the Bosque bottoms and in the adjoining prairie *(6)*.

With the suppression of Indian raids by 1848, the survey area was ripe for settlement. In 1850, McLennan County was organized. It had a population of several hundred people in that year. Waco had come into being as the site of the first post office in the survey area, though it would be another 6 years before the city government was established. By the 1850's, there was a local market for cattle. In 1854, the first trail herd, 500 steers, left Waco for Independence, Missouri. The next year, a herd was driven to Chicago, probably the only herd of Texas cattle ever driven to that city *(6)*. In 1860, the county had a population of more than 6,000, fed by a flood of immigrants chiefly from the southeastern part of the United States. Many of these early settlers arrived with their slaves to establish a plantation economy on the rich Brazos bottoms, where they began the cotton production that became the hallmark of McLennan County agriculture. Others set up businesses in the rapidly growing Waco, now a town of about 2,000. By 1861, the county had a number of open-range cattle operations on the prairies and ranching had become a major factor in the local economy *(12)*.

The Civil War (1861-66) stopped almost all economic activities, except for those that dealt directly with the conflict. McLennan County, which had an economy based largely on slaves and cotton, was solidly Confederate. During the war it supplied about 1,500 troops to the Confederacy, among which were six generals and a number of field grade officers *(6, 12)*.

With the end of the war, returning soldiers, freed slaves, and anticipatory businessmen all combined to encourage an optimism rare in the defeated South *(12)*. At the end of the war, the open range was swarming with unbranded cattle. In 1866, cattle drives began moving north through McLennan County along the Shawnee Trail to St. Louis. By 1870, northbound herds had become a flood and tens of thousands of cattle moving along the Chisholm Trail crossed the Brazos River at Waco *(6)*. From 1861 to the 1870's, the sale of cattle supplied most of the money for rebuilding the depressed economy left by the war.

Historic Maturity

The Waco and Northwestern Railroad reached Waco in 1872, providing farmers easy access to world markets for the first time. Waco became an industrial, marketing, and distribution center, and the county began to take on the complex economic character it retains today. Commerce and industry were concentrated in Waco, while agriculture dominated the rest of the county. The coming of the railroad was also the beginning of the end of the open range, for land which could grow cotton was now too valuable to be "wasted" on grazing *(12)*. With expanded agriculture, new market towns sprang up along the railroads and old towns died or moved to areas near the railroads, forming the current network of communities. Almost all of the small towns are inheritances from the early "Cotton Empire."

The era of open-range ranching in McLennan County finally ended with the drought of 1888. The return of wetter times brought conversion of rangeland into cotton land, and the county took on a character it would retain for the next 50 years. Improved farm income resulted in higher land prices, and even marginal prairie land, formerly of little value, became farmland used for cotton *(12)*.

The introduction of barbed wire in the 1800's for the first time allowed economical fencing. When the treeless Texas Blackland Prairie areas of eastern McLennan County were fenced, what had shortly before been a sea of tall grass was rapidly converted into plowed fields. Cotton production, which was 2,320 bales in 1860, grew to 8,829 bales in 1870 and 127,502 bales in 1911 *(12)*.

With increasing prosperity from agriculture and industry, McLennan County began to enjoy the benefits that wealth provides. Waco, which had been called "Six-shooter Junction," became "Athens on the Brazos" with the founding of Waco University in 1861 and Paul Quinn College in 1872, the arrival of Baylor University from Independence and its consolidation with Waco University in 1886, and the arrival of Add-Ran College

(later to move to Fort Worth as Texas Christian University) from Thorp Springs in 1895. Dozens of other private and public schools, churches, clubs, and major stores and offices served by streetcar lines rapidly converted Waco into a modern city. Railroads, interurban lines, and primitive roads joined Waco to other towns and cities in the county. Waco was not the only town in the county to benefit from the abundance of cotton. Most of the deteriorating brick streets, dilapidated but elaborate store fronts, and large homes still in the small towns of McLennan County date from the cotton boom.

World War I (1914-1918) greatly accelerated the industrialization of Waco and expanded the market for all agricultural products, among which cotton was paramount. The last of the Texas Blackland Prairie areas of eastern McLennan County and the far less suitable Grand Prairie grasslands west of Waco were quickly broken by the plow. Since the remaining prairie acreage was largely marginal land characterized by steep slopes and rapid runoff, erosion was severe, land values were soon lost, and clear streams became choked with mud. By 1920, cotton production had reached its peak, 140,243 bales. Cotton was so important to the economy of the county that the Texas Cotton Palace, the most prominent fair in county history (and in the State, second in attendance only to the Texas State Fair in Dallas), celebrated the reign of “King Cotton” each year from 1895 to 1924 *(6)*.

The era of plenty ended in the 1930’s, though the decline had begun slowly in the 1920’s. Industry slowed and stagnated. Railroads entered upon hard times. Marginal land, one-cropped to death, was abandoned. With the farm acts of the New Deal after 1932, large acreages were retired from cotton production. The remaining cropland, not under cotton allotment, was slowly converted to other uses. Landowners released the tenant farmers, who had been the mainstay of the cotton era, adding to the “dust bowl” migration so common in the early 1930’s.

The “Great Depression” lasted until 1939, the beginning of World War II in Europe. The war led to an era of industrial and agricultural activity under trying circumstances, in some ways preparing McLennan County for its next episode of population growth and population shift, which occurred at the end of the war in 1945. This latest episode (which continues today) was almost entirely of urban and industrial growth. To a significant degree, this growth was fed by retreat from the farms as mechanization reduced the need for human effort in the fields. With declining farm populations came similarly declining populations in the small towns and the corresponding urban growth of Waco and its suburbs.

In 1985, the population of McLennan County reached 184,000. Of this number, 138,600, or about 75 percent, lived in and near Waco. The total county income was about $\$1^1/_2$ billion. Agriculture and related activities accounted for only about 5 percent of the income *(7)*. Even with the emphasis on urban, industrial, and commercial development, however, agriculture is still a significant part of the economy in the county. In 1980, the county had more than 4,000 farms *(12)*. Industrial and commercial enterprises are centered in Waco and a few of the smaller towns. While the economy is clearly much more industrial and commercial than agricultural, agriculture is by far the most conspicuous activity in areas outside the industrial and commercial centers.

Natural Resources

Soil is the most important natural resource in McLennan County. The soils in the county formed mainly in material weathered from limestone, shale, and marl and have a high level of natural fertility. They are used for a wide range of purposes, including food, feed, fiber, and forage crops; pasture and range grasses for livestock; and habitat for wildlife. Good soils are the stimulus for a healthy economy.

Sand and gravel mining is a significant industry in McLennan County. Most gravel deposits are near the flood plains and terraces along the Brazos River. Limestone also is an important mineral. It is mined for use as building stone and as base material for roads. Some of the limestone is used in making cement.

Water is an important natural resource. The county has more than 19,500 acres of surface water in major lakes and rivers, including Lake Waco, Tradinghouse Lake, Lake Creek Lake, Lake Brazos, the Brazos River, and the Bosque River. More than 75 flood-prevention structures reduce the hazard of flooding in the county and provide water for livestock, wildlife, and recreation. Many small private ponds and lakes provide water for various uses. Most of the drinking water is pumped from wells or Lake Waco. Lake Waco is used for municipal, industrial, and recreational purposes and for flood control. Tradinghouse Lake and Lake Creek Lake are used for the cooling of power plants and for recreational purposes. The rivers are used for livestock water, recreational purposes, and some irrigation. The smaller lakes and ponds are used for livestock water, recreational purposes, and flood control.

Fish and wildlife are important natural resources in McLennan County. Much of the western part of the county is leased for hunting deer, quail, dove, and other wildlife. The lakes, ponds, and rivers are used for fishing.

Little income is derived from wood products. Some firewood is produced in the county, mainly from oak and associated species. Some posts are cut from the ashe juniper in the western part of the county.

Agriculture

Crops, livestock, and hay are the main agricultural products in McLennan County. The production of crops, mainly cotton, was the driving economic force in the county from 1880 to 1925. After that period, much marginal cropland was left idle and was converted to pasture or rangeland. Currently, most of the cropland is in the Texas Blackland Prairie part of the county and most of the rangeland is in the Grand Prairie part. Livestock, mainly beef cattle, are raised throughout the county.

Most crop production is concentrated on the deep, clayey soils in the county. The major crops are corn, grain sorghum, cotton, wheat, and oats. Other crops include peanuts, soybeans, watermelons, and truck crops that are grown on the sandy and loamy soils. Hay is an important agricultural product. Forage sorghum is the major crop planted for hay, and many areas of costal bermudagrass and kleingrass are harvested for hay. Other crops harvested for hay include johnsongrass, native grasses, oats, milo stalks, alfalfa, peanut vines, and cane. Corn and forage sorghum are sometimes harvested as silage for dairy feed.

Beef cattle, turkeys, dairy cattle, and hogs are the major livestock products in the county. Beef operations are mainly cow-calf enterprises, but some producers run stocker cattle on small grain in the winter. Cattle graze native rangeland, improved pasture, and areas of crops planted for grazing, such as wheat, oats, rye, and forage sorghum. Cattle are provided hay and supplemental feed in the winter. Beef cattle, dairy cattle, turkeys, and hogs all consume some of the grain produced on the cropland in the county.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at McGregor, Texas, in the period 1951 to 1986. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 47 degrees F and the average daily minimum temperature is 35 degrees. The lowest temperature on record, which occurred on December 25, 1983, is 4 degrees. In summer, the average temperature is 83 degrees and the average daily maximum temperature is 95 degrees. The highest recorded temperature, which occurred on June 28, 1980, is 109 degrees.

Growing degree days are shown in table 1. They are equivalent to “heat units.” During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 33.4 inches. Of this, nearly 19 inches, or more than 55 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 13.08 inches on June 16, 1964. Thunderstorms occur on about 45 days each year.

The average seasonal snowfall is about 1 inch. The greatest snow depth at any one time during the period of record was 5 inches. On the average, 1 day of the year has at least 1 inch of snow on the ground.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 75 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and

miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

Clayey Soils Formed in Residuum Derived From Shale and Marl; on Uplands

This group of general soil map units makes up about 26 percent of McLennan County. Ferris, Heiden, Houston Black, Slidell, and Sanger soils are dominant in this group. These soils formed in clayey material weathered from shale and marl of the Taylor Marl, Pepper Shale, South Bosque Shale, and Grayson Marl geological formations. The landscape is gently undulating to rolling. The native vegetation was a tall grass prairie with mainly little bluestem, indiangrass, switchgrass, and big bluestem.

Most of the soils in this group have a high shrink-swell potential, a high available water capacity, and high natural fertility and are well suited to most crops. Adapted crops include corn, cotton, grain sorghum, forage sorghum, and small grain. Improved bermudagrass, kleingrass, King Ranch bluestem, and Old World bluestem are adapted pasture plants.

The scenic, gently undulating countryside provides desirable homesites. Properly designing houses and roads helps to compensate for the shrinking and swelling of the clayey soils. The design of septic tank absorption fields should overcome restricted permeability, or alternative systems should be used.

1. Heiden-Houston Black-Ferris

Gently sloping to moderately steep, deep and very deep, clayey, well drained and moderately well drained soils

This map unit consists of clayey soils on broad upland prairies. Typically, Heiden soils are on ridgetops and side slopes, Houston Black soils are on foot slopes, and Ferris soils are on hillsides. The soils formed in clayey material weathered from shale and marl of the Pepper Shale, South Bosque Shale, and Taylor Marl geological formations of Upper Cretaceous age.

This map unit makes up about 20 percent of the county. It is about 42 percent Heiden soils, 25 percent Houston Black soils, 5 percent Ferris soils, and 28 percent other soils (fig. 2).

Heiden soils typically have a surface layer and subsurface layer of dark grayish brown clay. The subsoil is dark grayish brown, grayish brown, and light brownish gray clay. The underlying material is yellow shale with clay texture. The soils are moderately alkaline throughout.

Houston Black soils typically have a surface layer and subsurface layer of very dark gray clay. The subsoil is dark gray, gray, and grayish brown clay. The underlying material is yellow shale with clay texture. The soils are moderately alkaline throughout.

Ferris soils typically have a surface layer of light brownish gray clay. The subsoil is light yellowish brown clay. The underlying material is yellow and gray shale with clay texture. The soils are moderately alkaline throughout.

Of minor extent in this map unit are Austin, Branyon, Burleson, Eddy, Ellis, Fairlie, Gowen, Lamar, Lewisville, Lott, McLennan, Ovan, Stephen, Tinn, and Wilson soils. Austin, Eddy, and Stephen soils are along ridges. Branyon, Burleson, Lewisville, and Wilson soils are on broad, flat upland terraces. Ellis, Lamar,

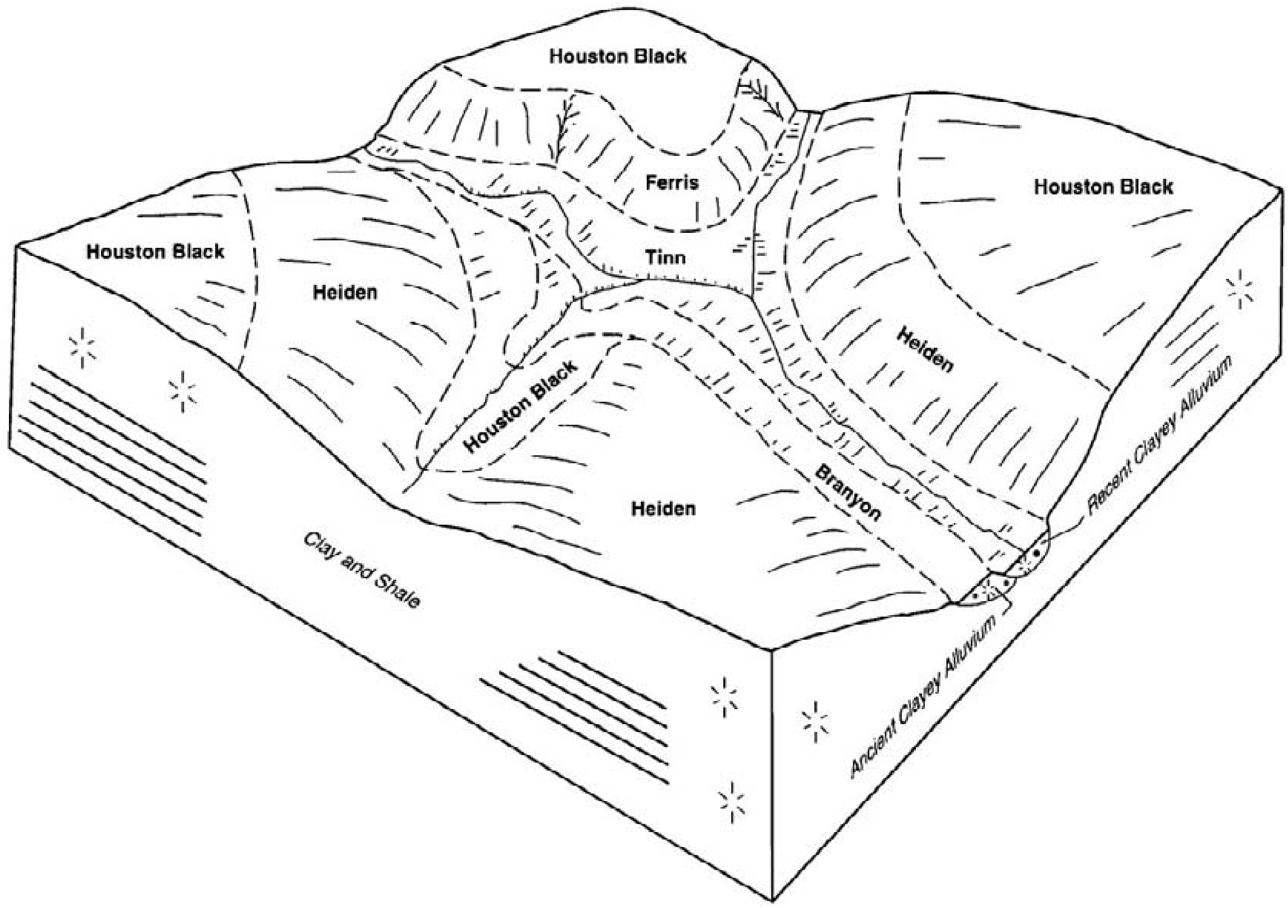

Figure 2.—Pattern of soils in the Heiden-Houston Black-Ferris general soil map unit.

Lott, and McLennan soils are along hillsides. Gowen, Ovan, and Tinn soils are on flood plains along local streams.

The soils in this map unit are used mainly as cropland. Some areas are used as pasture or rangeland.

The major crops are corn, cotton, grain sorghum, forage sorghum, and small grain. These soils have a high available water capacity.

The climax vegetation in areas of rangeland is a tall grass prairie with mainly little bluestem, indiangrass, switchgrass, big bluestem, and other grasses and forbs.

Most of the pasture and hayland supports improved bermudagrass or kleingrass.

A high shrink-swell potential and restricted permeability limit urban development. Properly designing houses and roads helps to compensate for the shrinking and swelling of the clayey soils. Properly designing septic tank absorption fields helps to overcome the restricted permeability.

2. Slidell-Sanger

Gently sloping, very deep, clayey, well drained and moderately well drained soils

This map unit consists of clayey soils on broad upland prairies. Typically, Slidell soils are on broad foot slopes, and Sanger soils are on hillsides and side slopes. The soils formed in clayey material weathered from shale and marl of the Grayson Marl geological formation of Lower Cretaceous age.

This map unit makes up about 6 percent of the county. It is about 58 percent Slidell soils, 16 percent Sanger soils, and 26 percent other soils (fig. 3).

Slidell soils typically have a surface layer and subsurface layer of very dark gray clay. The subsoil is grayish brown and light gray clay and silty clay. The underlying material is light brownish gray marl. The soils are moderately alkaline throughout.

Sanger soils typically have a surface layer and subsurface layer of dark grayish brown clay. The subsoil is grayish brown and light brownish gray

clay. The underlying material is yellow shale with clay texture. The soils are moderately alkaline throughout.

Of minor extent in this map unit are Branyon, Frio, Heiden, Houston Black, Lewisville, Lott, McLennan, Purves, Queeny, and Tinn soils. Branyon and Lewisville soils are on broad, flat upland terraces. Frio and Tinn soils are on flood plains. Heiden, Lott, and McLennan soils are on hillsides. Houston Black soils are on foot slopes. Purves and Queeny soils are on ridgetops.

The soils in this map unit are used mainly as cropland. Some areas are used as pasture or rangeland.

The major crops are corn, cotton, grain sorghum, forage sorghum, and small grain. These soils have a high available water capacity.

The climax vegetation in areas of rangeland is a tall grass prairie with mainly little bluestem, indiangrass, switchgrass, big bluestem, and a mixture of other grasses and forbs.

Most of the improved pasture and hayland supports improved bermudagrass or kleingrass.

A high shrink-swell potential and restricted permeability limit urban development. Properly designing houses and roads helps to compensate for the shrinking and swelling of the clayey soils. Properly designing septic tank absorption fields helps to overcome the restricted permeability.

Loamy and Clayey Soils Formed Mainly in Residuum Derived From Limestone; on Uplands

This group of general soil map units makes up about 22 percent of McLennan County. Aledo, Bolar,

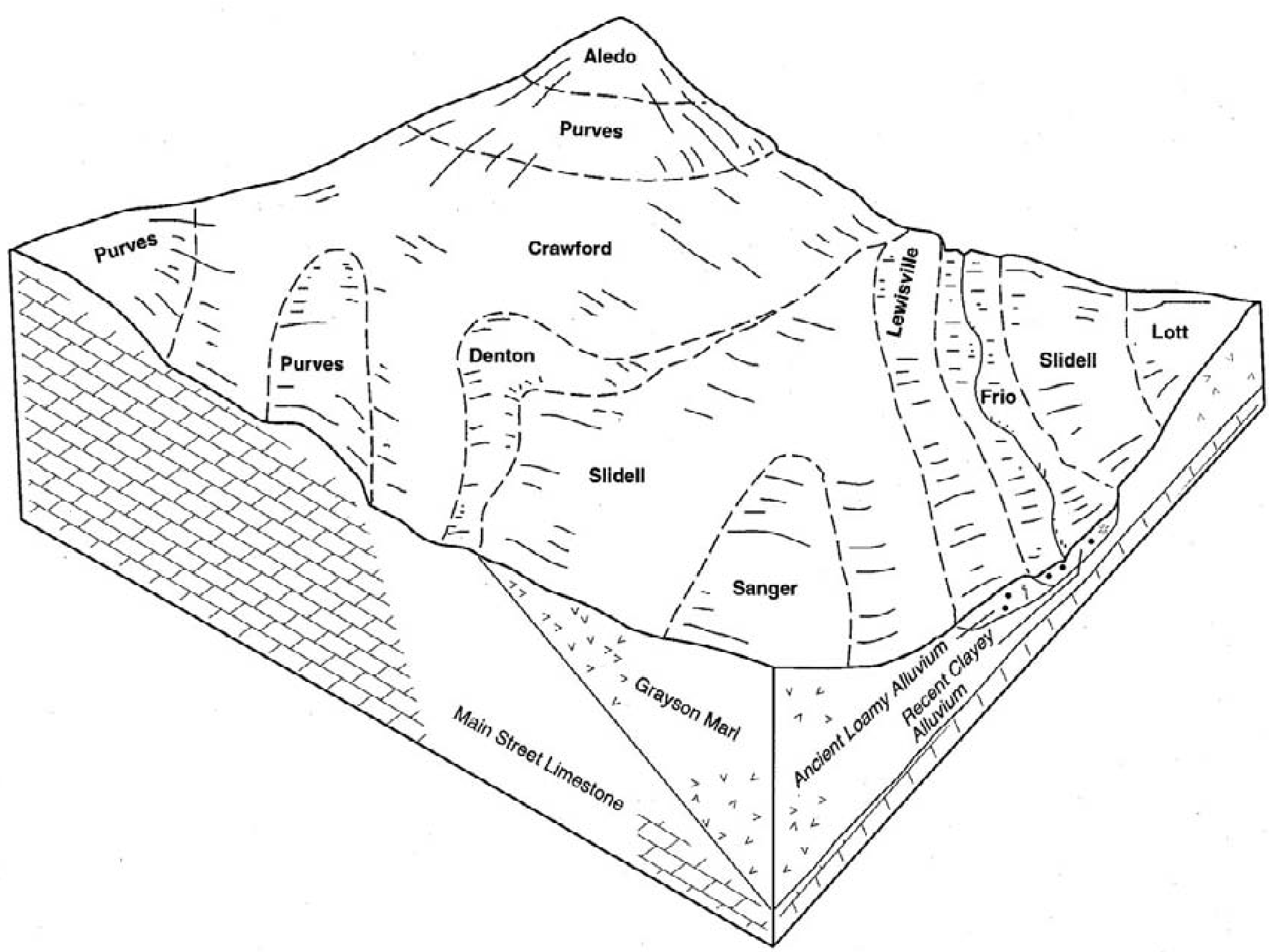

Figure 3.—Pattern of soils in the Crawford-Purves and Slidell-Sanger general soil map units.

Crawford, Denton, Eckrant, and Purves soils are dominant in this group. These soils formed mainly in material weathered from limestone of the Main Street Limestone, Pawpaw, Weno, Kiamichi Clay, and Edwards Limestone geological formations. The landscape is gently undulating to hilly. The native vegetation was a tall grass prairie with mainly little bluestem, indiangrass, sideoats grama, Texas wintergrass, switchgrass, and other plants. Motts of live oak are in scattered areas. Live oak, elm, hackberry, ash, and juniper trees are common along breaks.

In most areas the soils in this group have a low or moderate available water capacity and high natural fertility. Because of rock fragments and the depth to bedrock, they are best suited to native rangeland. Many areas of moderately deep soils are used for crops, mainly small grain and grain sorghum. Improved bermudagrass, kleingrass, King Ranch bluestem, and Old World bluestem are adapted pasture plants.

The scenic hills and valleys provide desirable homesites. The limestone bedrock is a good foundation for houses and roads, but it commonly is difficult to excavate. Installing septic tank absorption fields in the limestone is difficult. Ground water should be protected from effluent contamination.

3. Aledo-Eckrant

Gently sloping to moderately steep, very shallow and shallow, loamy and clayey, well drained soils with a high content of gravel and cobbles

This map unit consists of gravelly and cobbly, loamy and clayey soils on rolling prairies. Typically, Aledo soils are on broad, rolling, benched ridges and hillsides, Eckrant soils are on hilltops and divides, and Brackett soils are on hillsides and side slopes. The soils formed in limestone residuum and marl of the Kiamichi Clay, Duck Creek, Papaw, Weno, and Edwards Limestone geological formations of Lower Cretaceous age.

This map unit makes up about 9 percent of the county. It is about 55 percent Aledo soils, 8 percent Eckrant soils, and 37 percent other soils (fig. 4).

Aledo soils typically have a surface of dark grayish brown gravelly clay loam. The subsurface layer is dark grayish brown very gravelly clay loam. The underlying material is fractured limestone bedrock.

Eckrant soils typically have a surface layer of dark brown cobbly silty clay. The underlying material is coarsely fractured limestone bedrock.

Of minor extent in this map unit are Bolar, Brackett, Crawford, Denton, Frio, Krum, Lewisville, Oglesby, Purves, Real, San Saba, Sanger, Slidell, and Sunev soils. Bolar soils are on hillsides. Brackett and Real soils are along hillsides and side slopes. Crawford, Purves, Oglesby, and San Saba soils are on broad ridges and flats. Denton, Krum, Sanger, and Slidell soils are on foot slopes. Frio soils are on flood plains. Lewisville and Sunev soils are on upland terraces near the major steams. Large pits are in areas where the limestone bedrock has been quarried for road base.

The soils in this map unit are used mainly as rangeland. Some areas are used as pasture, and a few small fields are used as cropland.

There is very little cropland in this map unit. The major crops are small grain and forage sorghum used as supplemental feed for livestock.

The climax vegetation in areas of rangeland consists of tall, mid, and short native grasses. It includes little bluestem, sideoats grama, indiangrass, switchgrass, other native grasses, and scattered motts of live oak. Juniper trees are mainly along breaks to streams.

Most of the pasture or hayland is in small areas along foot slopes and in stream valleys. These areas are used to produce forage for supplemental winter feeding. Most of the areas support improved bermudagrass and kleingrass. King Ranch bluestem has been established in some areas.

The content of cobbles and gravel and the depth to bedrock limit urban development. The scenic hills and valleys with scattered trees commonly are desirable sites for houses. The limestone bedrock is difficult to excavate. On the shallow and very shallow soils, lawns are difficult to establish and septic systems are difficult to install. In some areas the underlying limestone is a valuable source of material for building roads and foundations. Most of the limestone quarries are in areas of the Eckrant soils and the Edwards Limestone geological formation.

4. Crawford-Purves

Nearly level and gently sloping, shallow and moderately deep, loamy and clayey, well drained soils

This map unit consists of clayey soils on nearly level and gently undulating prairies. Typically, Crawford soils are on broad, nearly level and gently sloping ridges and divides, and Purves soils are on hillsides and foot slopes. The soils formed in material weathered from the Main Street Limestone geological formation of Lower Cretaceous age.

This map unit makes up about 7 percent of the county. It is about 46 percent Crawford soils, 31 percent Purves soils, and 23 percent other soils (fig. 3).

Crawford soils typically have a surface layer of dark reddish gray clay. The subsoil is reddish brown clay

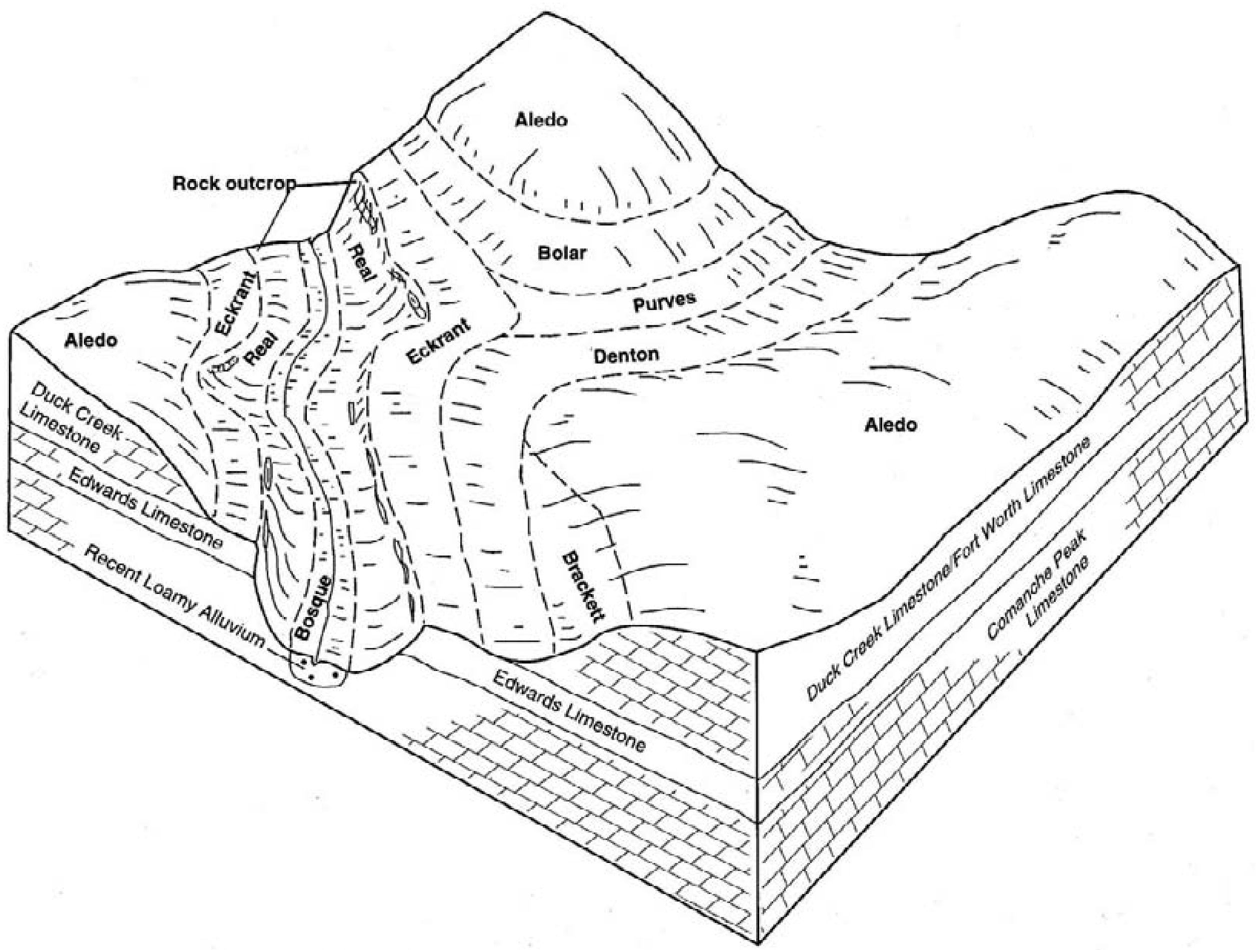

Figure 4.—Pattern of soils in the Aledo-Eckrant general soil map unit.

and reddish brown and yellowish red gravelly silty clay. The underlying material is fractured limestone bedrock. The soils are slightly acid to moderately alkaline throughout.

Purves soils typically have a surface layer of brown clay. The subsurface layer is brown gravelly clay. The subsoil is brown very gravelly clay. The underlying material is fractured limestone bedrock. The soils are moderately alkaline throughout.

Of minor extent in this map unit are Aledo, Bosque, Denton, Frio, Lewisville, Queeny, San Saba, Sanger, and Slidell soils. Aledo soils are on broad ridgetops. Bosque and Frio soils are on flood plains. Denton, San Saba, Sanger, and Slidell soils are on foot slopes. Lewisville soils are on upland terraces. Queeny soils are on small knolls and hilltops. Large pits are in areas where the underlying limestone has been quarried for road base and fill material.

The soils in this map unit are used mainly as cropland. Some areas are used as rangeland or pasture.

The major crops are wheat, oats, forage sorghum, and grain sorghum. Some areas are used for cotton or corn, but the depth to bedrock limits the amount of available moisture and most of the cropland is used for cool-season crops.

The climax vegetation in areas of rangeland consists of tall native grasses, mainly little bluestem, indiangrass, switchgrass, and big bluestem with a mixture of other grasses and forbs. There are few trees.

Most of the pasture and hayland supports improved bermudagrass and kleingrass. Some areas of johnsongrass are managed for hay.

The shallow or moderately deep soil depth and a high shrink-swell potential in the clayey soils may limit urban development. The limestone bedrock is difficult

to excavate when roads are built and septic systems are installed. The city of McGregor is in this map unit.

5. Bolar-Denton

Gently sloping, moderately deep and deep, gravelly and nongravelly, loamy and clayey, well drained soils

This map unit consists of gravelly and nongravelly, loamy and clayey soils on gently undulating prairies. Typically, Bolar soils are on hillsides and rounded hilltops, and Denton soils are on foot slopes and side slopes. The soils formed in stratified limestone residuum and marl of the Kiamichi Clay and Edwards Limestone geological formations of Lower Cretaceous age.

This map unit makes up about 6 percent of the county. It is about 34 percent Bolar soils, 29 percent Denton soils, and 37 percent other soils.

Bolar soils typically have a surface layer and subsurface layer of dark brown gravelly clay loam. The subsoil is brown gravelly clay loam. The underlying material is fractured limestone bedrock. The soils are moderately alkaline throughout.

Denton soils typically have a surface layer and subsurface layer of dark grayish brown silty clay. The subsoil is brown, very pale brown, and brownish yellow silty clay loam. The underlying material is fractured limestone bedrock interbedded with soft marl. The soils are moderately alkaline throughout.

Of minor extent in this map unit are Aledo, Bosque, Brackett, Crawford, Eckrant, Frio, Krum, Lewisville, Oglesby, Purves, Real, Sanger, Slidell, and Sunev soils. Aledo soils are on ridgetops. Bosque and Frio soils are on flood plains. Brackett and Real soils are on hillsides and sharp breaks. Crawford, Eckrant, Oglesby, and Purves soils are on hilltops and flats above scarps. Krum soils are in valley fills and on foot slopes. Lewisville and Sunev soils are upland terraces near the major streams. Sanger and Slidell soils are on foot slopes. In some areas the soil has been removed and the underlying material quarried for road base.

The soils in this map unit are used mainly as cropland or rangeland. Some areas are used as pasture.

The major crops are wheat, oats, and forage sorghum. Some grain sorghum is grown. The crops are used for supplemental grazing by livestock. The moderately deep soils are best suited to cool-season crops.

The climax vegetation in areas of rangeland consists of tall and short native grasses. It includes little bluestem, sideoats grama, indiangrass, switchgrass, and other native grasses with scattered motts of live oak. Juniper trees grow mostly along breaks to streams.

Most of the pasture and hayland supports improved bermudagrass and kleingrass. Some areas support King Ranch bluestem. Most of the hayland is used to produce supplemental forage for winter feeding.

The content of gravel, the depth to bedrock, and the distance to urban centers may limit urban development. Many of the scenic hills and valleys would make desirable homesites. The limestone bedrock is difficult to excavate. In some areas the underlying limestone is a potentially valuable source of material for the base of roads and for foundations.

Loamy and Clayey Soils Formed in Alluvial Sediments Along Local Streams; on Uplands and Pleistocene-Age Terraces

This group of general soil map units makes up about 15 percent of McLennan County. Branyon, Bremond, Burleson, Mabank, Payne, and Wilson soils are dominant in this group. These soils formed in loamy and clayey Pleistocene-age terrace deposits along local streams. The landscape generally is nearly level, but the beveled edges of terraces are strongly sloping. The native vegetation was a tall grass prairie with mainly little bluestem, indiangrass, big bluestem, and other native grasses. Trees include post oak, elm, hackberry, and pecan.

Most of the soils in this group have a moderate or high shrink-swell potential. Most are well suited to cropland, although seasonal wetness may affect crop production in some areas. Adapted crops include corn, cotton, grain sorghum, forage sorghum, and small grain. Improved bermudagrass, King Ranch bluestem, and Old World bluestem are adapted pasture plants.

Because of the nearly level topography and slow runoff, these soils are less desirable as homesites than many of the other soils in the county. Properly designing houses and roads helps to compensate for wetness and for shrinking and swelling of the clayey soils. The design of septic tank absorption fields should overcome restricted permeability, or alternative systems should be used.

6. Wilson-Bremond-Mabank

Nearly level and gently sloping, very deep, loamy, moderately well drained soils

This map unit consists of loamy soils on broad, flat claypan prairie uplands. Typically, Wilson soils are in nearly level areas, and Bremond and Mabank are on the slightly higher rises and on flats. The soils formed in clayey Pleistocene-age terrace deposits along local streams.

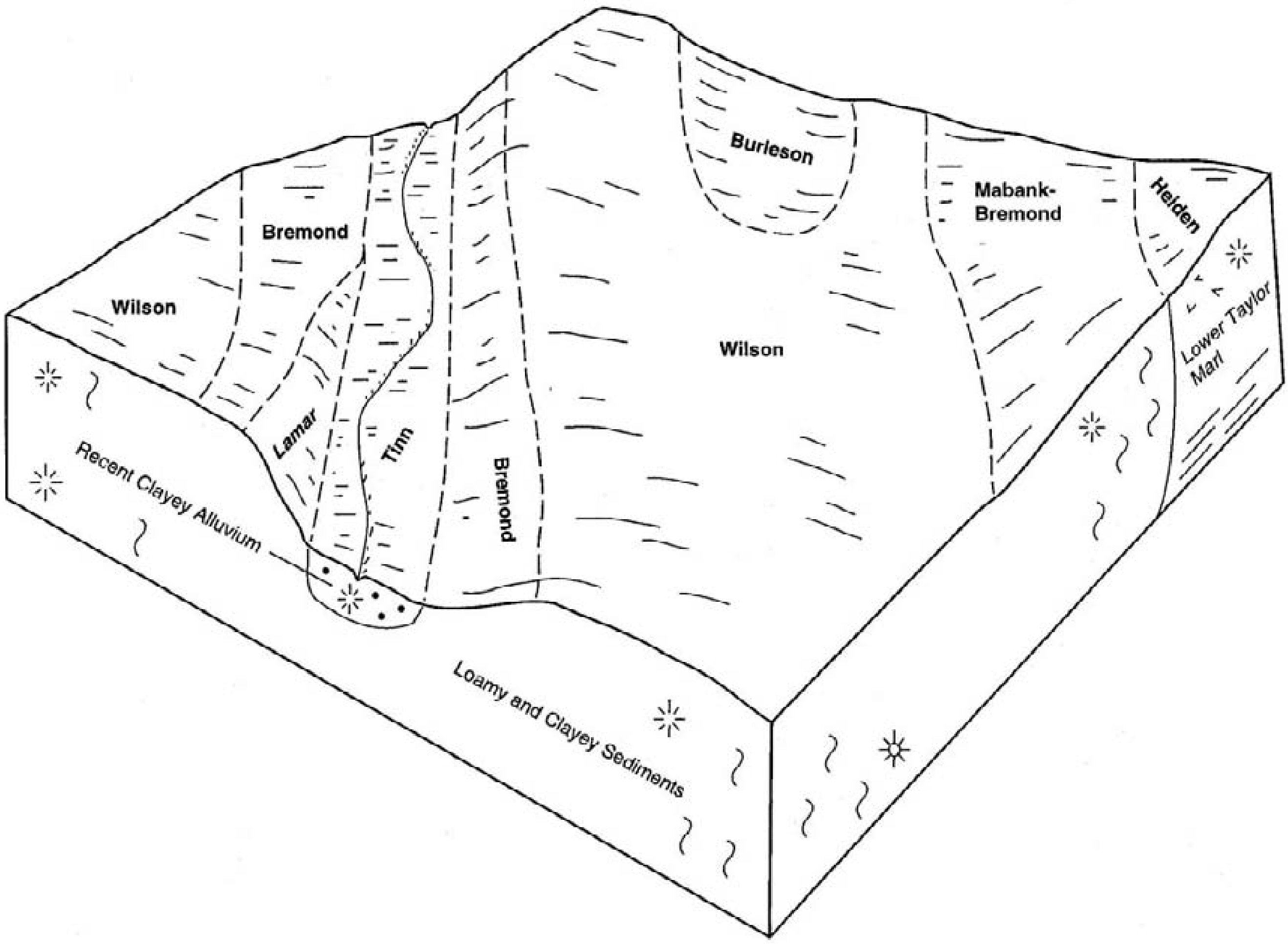

Figure 5.—Pattern of soils in the Wilson-Bremond-Mabank general soil map unit.

This map unit makes up about 8 percent of the county. It is about 53 percent Wilson soils, 12 percent Bremond soils, 10 percent Mabank soils, and 25 percent other soils (fig. 5).

Wilson soils typically have a surface layer of dark grayish brown clay loam. The subsoil is dark gray and very dark gray clay. The underlying material is reddish yellow clay. The soils are moderately acid to neutral in the surface layer and in the upper part of the subsoil and moderately alkaline in the lower part of the subsoil.

Bremond soils typically have a surface layer of light yellowish brown loam. The subsoil is brown, dark yellowish brown, and yellowish brown clay. The soils are moderately acid to neutral in the surface layer and moderately acid to moderately alkaline in the subsoil.

Mabank soils typically have a surface layer of grayish brown fine sandy loam. The subsoil is very dark gray, gray, and grayish brown clay. The soils are slightly acid or neutral in the surface layer and moderately acid to moderately alkaline in the subsoil.

Of minor extent in this map unit are Axtell, Branyon, Burleson, Crockett, Gowen, Heiden, Houston Black, Lamar, Minwells, Ovan, and Tinn soils. Axtell, Crockett, Heiden, Houston Black, and Minwells soils are on hillsides and slight ridges. Branyon and Burleson soils are on broad flats and in slight depressions. Gowen, Ovan, and Tinn soils are on flood plains. Lamar soils are on hillsides and breaks.

The soils in this map unit are used mainly as cropland or pasture. A few areas are managed as native rangeland or are idle.

The major crops are small grain, forage sorghum, and grain sorghum. Some areas are used for cotton or corn, but a moderate available water capacity may limit yields.

The climax vegetation in areas of rangeland is a tall grass prairie with mainly little bluestem, indiangrass, and other grasses and forbs.

Most of the pasture and hayland supports improved bermudagrass or common bermudagrass.

A high shrink-swell potential in the subsoil and seasonal wetness in the flat areas limit urban development. Restricted permeability in the subsoil affects septic systems. The extreme eastern part of Waco is in this map unit.

7. Branyon-Burleson

Nearly level and gently sloping, very deep, clayey, moderately well drained soils

This map unit consists of clayey soils on broad, flat upland prairies. Typically, Branyon soils are on broad flats and slight knolls, and Burleson soils are in slight depressions and on flats. The soils formed in clayey Pleistocene-age terrace deposits along local streams.

This map unit makes up about 6 percent of the county. It is about 39 percent Branyon soils, 24 percent Burleson soils, and 37 percent other soils.

Branyon soils typically have a surface layer of very dark gray clay. The subsoil is very dark gray, dark grayish brown, and pale brown clay. The soils are moderately alkaline throughout.

Burleson soils typically have a surface layer of dark gray clay. The subsoil is dark gray, gray, and grayish brown clay. The soils are slightly acid to moderately alkaline throughout.

Of minor extent in this map unit are Bremond, Houston Black, Lamar, Lewisville, Payne, Tinn, and Wilson soils. Bremond and Wilson soils are on broad flats. Houston Black soils are on foot slopes near the higher lying soils. Lamar soils are along slope breaks to local streams. Lewisville and Payne soils are on slightly convex slopes. Tinn soils are on flood plains.

The soils in this map unit are used mainly as cropland. Some areas are used as pasture or rangeland.

The major crops are corn, cotton, grain sorghum, forage sorghum, and some wheat. These soils have a high available water capacity.

The climax vegetation in areas of rangeland is a tall grass prairie with mainly little bluestem, indiangrass, switchgrass, big bluestem, and other grasses and forbs.

Most of the pastures support improved bermudagrass.

A high shrink-swell, restricted permeability, and the flat slopes limit urban development. Properly designing houses and roads helps to compensate for the shrinking and swelling of the clayey soils. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Part of the city of Waco is in this map unit.

8. Payne

Gently sloping, very deep, loamy, well drained soils

This map unit consists of loamy soils on gently undulating upland prairies. Typically, Payne soils are on broad, gently sloping plains. They formed in loamy and clayey sediments on terraces along local streams.

This map unit makes up about 1 percent of the county. It is about 56 percent Payne soils and 44 percent other soils.

Payne soils typically have a surface layer of dark grayish brown clay loam. The upper part of the subsoil is brown clay, and the lower part is yellowish red clay. The soils are slightly acid or neutral in the surface layer, neutral in the upper part of the subsoil, and moderately alkaline in the lower part of the subsoil.

Of minor extent in this map unit are Lewisville, McLennan, Queeny, and Wilson soils. Lewisville soils are on convex slopes in the slightly lower areas. McLennan soils are along hillsides and side slopes. Queeny soils are on small knolls or landscape breaks. Wilson soils are on nearly level flats in slight depressions.

The soils in this map unit are used mainly as cropland or rangeland. The unit borders Lake Waco, and some areas are used for recreation.

The major crops are grain sorghum, small grain, and forage sorghum. These soils have a high available water capacity.

The climax vegetation in areas of rangeland is a tall grass prairie with mainly little bluestem, indiangrass, switchgrass, big bluestem, and other grasses and forbs.

Most of the pastures support improved bermudagrass.

Restricted permeability in the subsoil and the shrink-swell potential may limit urban development. Properly designing houses and roads helps to compensate for a moderate shrink-swell potential in the subsoil. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The Madison-Cooper Airport is in an area of this map unit.

Loamy and Clayey Soils Formed in Residuum Derived From Chalk and Marl; on Uplands

This group of general soil map units makes up about 15 percent of McLennan County. Austin, Eddy, Fairlie, Lott, McLennan, and Stephen soils are dominant in this group. These soils formed in loamy

and clayey material weathered from the Austin Chalk and Lake Waco geological formations. The landscape is gently undulating to strongly rolling. The native vegetation was a tall grass prairie with mainly little bluestem, indiangrass, switchgrass, big bluestem, and other native grasses.

In most areas the soils in this group have a low or moderate available water capacity. They are best suited to range and pasture, but some soils are suited to cropland. The major crops are small grain, forage sorghum, and grain sorghum. Improved bermudagrass, kleingrass, King Ranch bluestem, and Old World bluestem are adapted pasture plants.

The scenic, undulating countryside provides desirable homesites. Properly designing houses and roads helps to compensate for the shrinking and swelling of the soils. Some areas are underlain by chalky bedrock. Properly designing septic tank absorption fields helps to prevent the contamination of ground water and helps to overcome restricted permeability.

9. Eddy-Stephen

Gently sloping to strongly sloping, very shallow and shallow, loamy and clayey, well drained soils

This map unit consists of clayey and loamy soils on gently undulating, high prairies. Typically, Eddy soils are on hillsides and breaks, and Stephen soils are on broad ridges and divides. The soils formed in material weathered from soft chalk of the Austin Chalk geological formation of Upper Cretaceous age.

This map unit makes up about 6 percent of the county. It is about 36 percent Eddy soils, 30 percent Stephen soils, and 34 percent other soils (fig. 6).

Eddy soils typically have a surface layer of brown gravelly clay loam. The subsoil is brown very gravelly clay loam. The underlying material is white, chalky limestone interbedded with chalky marl. The soils are moderately alkaline throughout.

Stephen soils typically have a surface layer of dark brown silty clay. The subsoil is platy chalk interbedded with dark brown silty clay. The underlying material is pink and white, platy chalk.

Of minor extent in this map unit are Austin, Fairlie, Ferris, Heiden, Houston Black, Lott, McLennan, and Slidell soils and Urban land. Austin, Fairlie, and Houston Black soils are on foot slopes. Ferris, Lott, and McLennan soils are on hillsides and side slopes. Heiden and Slidell soils are on side slopes. Urban land is within the city limits of Waco.

The soils in this map unit are used mainly for rangeland or urban development. A few areas are used as cropland.

The major crops are wheat, oats, and forage sorghum. A very low available water capacity limits the yields of many crops.

The climax vegetation in areas of rangeland consists of mid and tall native grasses, mostly little bluestem, sideoats grama, and indiangrass.

Improved bermudagrass, kleingrass, and King Ranch bluestem have been established in some areas.

The chalky subsoil provides a good foundation for buildings and roads. Excavation of the chalky limestone is difficult. These soils are very easily eroded. Lawns are difficult to establish on the very shallow and shallow soils. Sewage effluent can contaminate ground water. Much of the city of Waco is in this map unit. Highway I-35 passes through the unit.

10. Fairlie-Austin

Gently sloping, moderately deep and deep, clayey, well drained and moderately well drained soils

This map unit consists of clayey soils on gently undulating prairies. Typically, Fairlie soils are on foot slopes, and Austin soils are on hillsides and ridgetops. The soils formed in material weathered from soft chalk and marl of the Austin Chalk geological formation of Upper Cretaceous age.

This map unit makes up about 5 percent of the county. It is about 38 percent Fairlie soils, 32 percent Austin soils, and 30 percent other soils (fig. 6).

Fairlie soils typically have a surface layer and subsurface layer of very dark gray clay. The subsoil is very dark gray and grayish brown clay. The underlying material is white, platy chalk. The soils are moderately alkaline throughout.

Austin soils typically have a surface layer of dark grayish brown silty clay. The subsurface layer is dark brown silty clay. The subsoil is brown silty clay with chalk fragments. The underlying material is white, platy chalk. The soils are moderately alkaline throughout.

Of minor extent in this map unit are Eddy, Heiden, Houston Black, Lewisville, Lott, McLennan, Stephen, and Tinn soils and Urban land. Eddy, Lott, and McLennan soils are on hillsides and breaks. Heiden and Stephen soils are on side slopes. Houston Black soils are on foot slopes. Lewisville soils are on terraces near streams. Tinn soils are on flood plains. Urban land is within the city limits of Waco.

The soils in this map unit are used mainly as cropland or pasture. Some areas are used for urban development.

The major crops are corn, cotton, grain sorghum, small grain, and forage sorghum. A low or moderate

available water capacity limits crop yields in some years.

The climax vegetation in areas of rangeland is a tall native grass prairie with mainly little bluestem, switchgrass, big bluestem, indiangrass, and other native grasses.

Most of the pastures support improved bermudagrass. Some areas support kleingrass or King Ranch bluestem.

A high shrink-swell potential and restricted permeability limit urban development. Properly designing houses and roads helps to compensate for the shrinking and swelling of the clayey soils. Much of the city of Waco is in this map unit. Highway I-35 passes through the unit.

11. Lott-McLennan

Gently sloping to moderately steep, very deep, loamy and clayey, well drained soils

This map unit consists of loamy and clayey soils on gently undulating to strongly rolling prairies. Typically, Lott soils are on hillsides, side slopes, and the lower slopes, and McLennan soils are on the steeper side slopes and escarpments. The soils formed in material weathered from the Lake Waco geological formation of Upper Cretaceous age.

This map unit makes up about 4 percent of the county. It is about 62 percent Lott soils, 28 percent McLennan soils, and 10 percent other soils.

Lott soils typically have a surface layer of dark

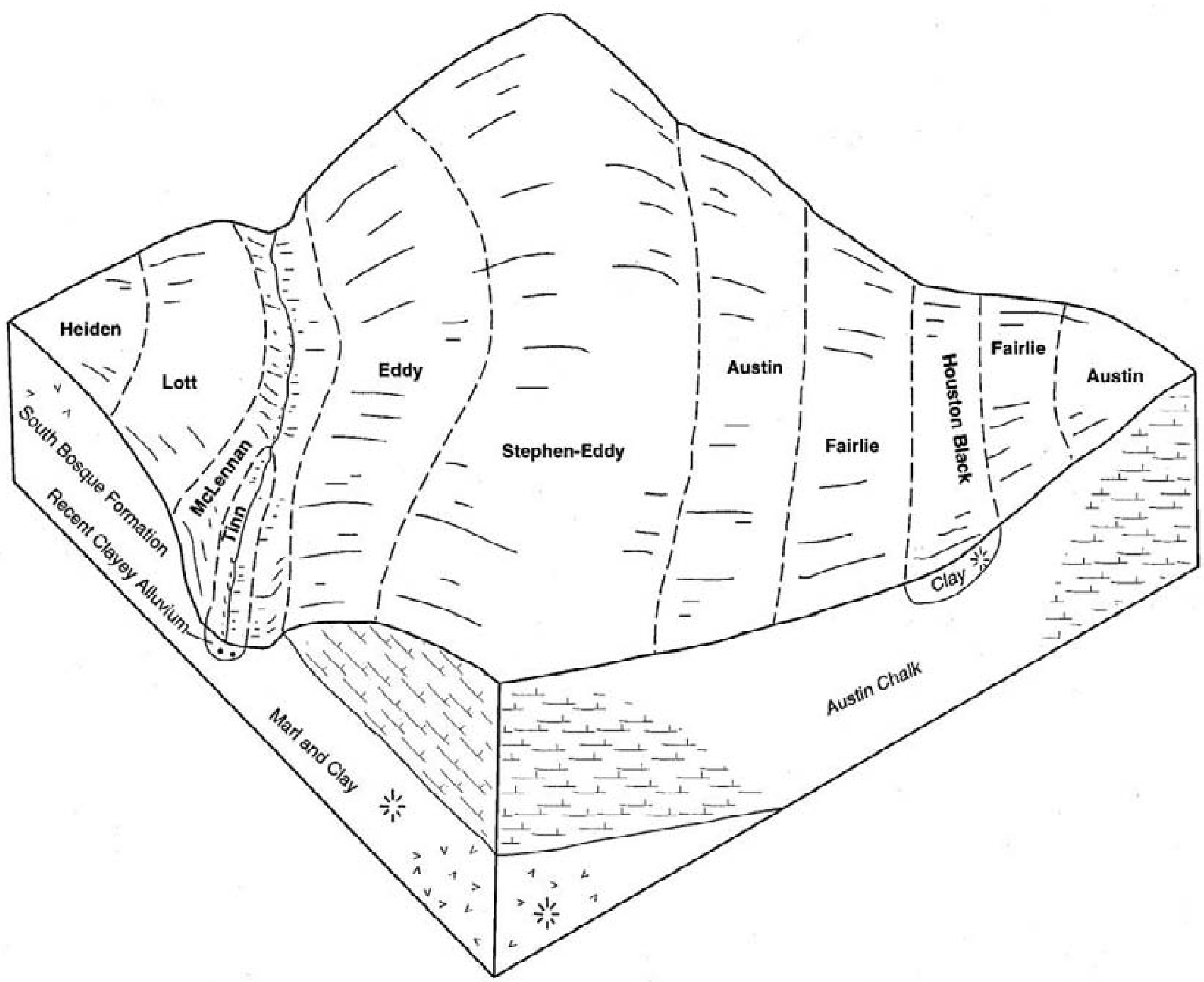

Figure 6.—Pattern of soils in the Eddy-Stephen and the Fairlie-Austin general soil map units.

brown silty clay. The subsurface layer is brown silty clay. The subsoil is brown and reddish yellow silty clay. The underlying material is reddish yellow silty clay loam and clayey marl. The soils are moderately alkaline throughout.

McLennan soils typically have a surface layer of grayish brown clay loam. The subsoil is light olive brown and light yellowish brown clay loam. The underlying material is olive yellow silty clay loam interbedded with limestone and weathered shale.

Of minor extent in this map unit are Eddy, Ellis, Ferris, Heiden, Stephen, and Tinn soils. Eddy, Ellis, and Ferris soils are on the steeper hillsides and side slopes. Heiden soils are on ridgetops and divides. Stephen soils are on side slopes. Tinn soils are on flood plains.

The soils in this map unit are used mainly as rangeland or pasture. A few areas are used as cropland.

Most of this unit is not used as cropland because of the slope and a severe hazard of erosion. A few areas of the less sloping soils are used for grain sorghum, small grain, or forage sorghum.

The climax vegetation in areas of rangeland is a tall native grass prairie with mainly little bluestem, indiangrass, and other native grasses and forbs.

Most of the pasture and hayland supports improved bermudagrass, kleingrass, or King Ranch bluestem. Most of the hay is used as supplemental forage for livestock.

The slope, a severe hazard of erosion, and a high shrink-swell potential limit urban development. Many hilltops provide scenic homesites, but access and road building are difficult. Properly designing houses and roads helps to overcome the shrink-swell potential and reduces the hazard of erosion.

Loamy and Clayey Soils Formed in Alluvium; on Flood Plains

This group of general soil map units makes up about 11 percent of McLennan County. Bosque, Frio, Ovan, Ships, Tinn, Weswood, and Yahola soils are dominant in this group. These soils formed in loamy and clayey Holocene-age alluvial sediments along the major streams. The landscape generally is nearly level. The native vegetation was a tall grass prairie with scattered pecan, cottonwood, and elm trees. The dominant grasses were little bluestem, indiangrass, switchgrass, and big bluestem.

Most of the soils in this group have a high available water capacity and high natural fertility. Most are suited to cropland, but some areas are frequently flooded and are not well suited to cultivation. Adapted crops include corn, cotton, grain sorghum, forage sorghum, and small grain. Improved bermudagrass and kleingrass are adapted pasture plants.

The hazard of flooding limits these soils as homesites, but many homes have been constructed in areas along the Brazos River where Whitney, Aquilla, and other dams provide some protection against flooding. Although protected, these areas still can be flooded.

12. Weswood-Yahola-Ships

Nearly level and gently sloping, very deep, loamy and clayey, well drained and moderately well drained soils

This map unit consists of loamy and clayey soils on flood plains along the Brazos River. Typically, Weswood soils are on nearly level flats. Yahola soils generally are closer to the river, in the slightly higher areas of overbank deposits near stream meanders. Ships soils typically are in the lower, slightly depressed back-swamp areas. The soils formed in loamy and clayey recent alluvium along the Brazos River.

This map unit makes up about 5 percent of the county. It is about 40 percent Weswood soils, 21 percent Yahola soils, 18 percent Ships soils, and 21 percent other soils (fig. 7).

Weswood soils typically have a surface layer of reddish brown silt loam. The subsoil is reddish brown and yellowish red silt loam. The underlying material is reddish yellow silt loam. The soils are moderately alkaline throughout.

Yahola soils typically have a surface layer of pale brown very fine sandy loam. The underlying material is stratified yellowish red and reddish yellow very fine sandy loam and loamy fine sand. The soils are moderately alkaline throughout.

Ships soils typically have a surface layer of brown clay. The subsurface layer and subsoil are reddish brown clay. The underlying material is reddish brown silty clay loam.

Of minor extent in this map unit are Gaddy soils, gravel pits, Tinn soils, and Urban land. Gaddy soils are adjacent to the river. Gravel pits are in areas where the soil has been removed and the underlying gravel has been mined. Tinn soils are in nearly level areas where local streams merge with the Urban land on the flood plains along the Brazos River.

The soils in this map unit are used mainly as pasture or cropland. The flood plains north of Waco are narrow and are used mainly as pasture. The flood plains south of Waco are wider and are used more extensively as cropland. Some areas in the city of

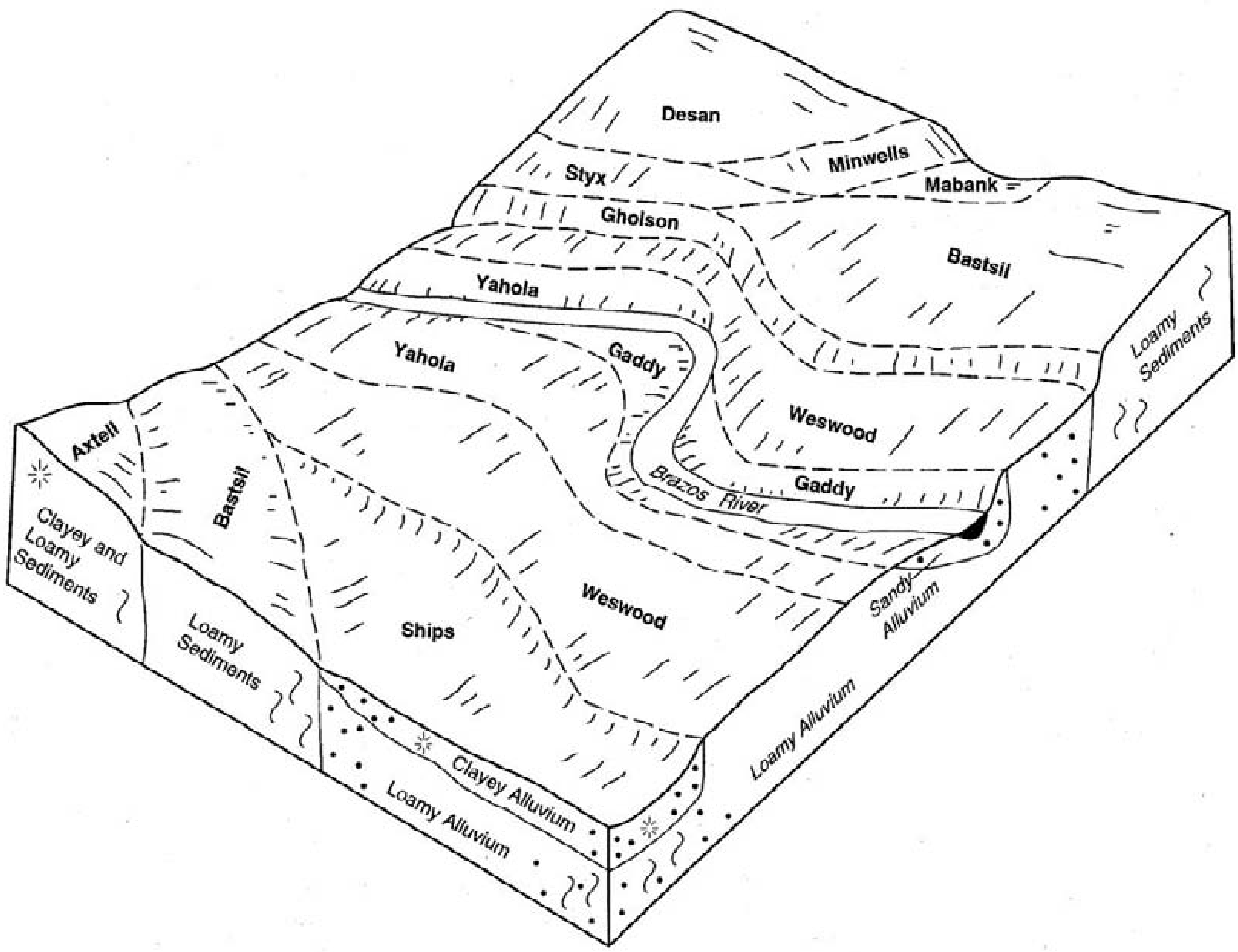

Figure 7.—Pattern of soils in the Weswood-Yahola-Ships general soil map unit.

Waco and mostly north of the city are used mainly for urban or recreational development.

The major crops are corn, grain sorghum, small grain, and forage sorghum. Some areas are used for vegetables or truck crops. The available water capacity is moderate or high.

The climax vegetation in areas of rangeland consists of tall native grasses, mostly little bluestem, switchgrass, big bluestem, and indiangrass. The vegetation includes scattered trees, such as pecan, cottonwood, elm, and live oak.

Most of the pasture and hayland supports improved bermudagrass.

Flooding is the major hazard affecting urban development. Several major dams have been built on the Brazos River, the Bosque River, and local streams, but flooding is still possible.

13. Tinn-Ovan

Nearly level, very deep, clayey, moderately well drained soils

This map unit consists of clayey soils on broad, nearly level flood plains along local streams, mostly in the eastern part of the county. Typically, Tinn soils are on slightly depressed flats, and Ovan soils are in the slightly higher areas that are flooded less frequently. The soils formed in clayey Holocene-age alluvium along local streams.

This map unit makes up about 4 percent of the county. It is about 53 percent Tinn soils, 24 percent Ovan soils, and 23 percent other soils.

Tinn soils typically have a surface layer of dark gray clay. The subsurface layer is very dark gray clay. The subsoil is very dark gray and grayish brown clay. The

underlying material is light gray clay. The soils are moderately alkaline throughout.

Ovan soils typically have a surface layer of dark grayish brown silty clay. The subsurface layer is grayish brown silty clay. The subsoil is pale brown silty clay. The soils are moderately alkaline throughout.

Of minor extent in this map unit are Branyon, Frio, Gowen, Lamar, and Lewisville soils. Branyon soils are on the higher flat terraces. Frio soils are in the slightly higher areas of overbank deposits near streams. Gowen soils are mainly near the head of drainageways, mostly the smaller drainageways. Lamar soils are on the side slopes of terraces. Lewisville soils are on gently sloping terrace edges.

The soils in this map unit are used mainly as pasture or rangeland. Some areas are used as cropland.

The major crops are corn, cotton, and grain sorghum. These soils have a high available water capacity. Cropping is risky because of the hazard of flooding.

The climax vegetation in areas of rangeland is a tall native grass prairie with mainly little bluestem, big bluestem, indiangrass, eastern gamagrass, and switchgrass and scattered elm and pecan trees.

Most of the improved pastures support improved bermudagrass. Many areas are managed as johnsongrass hay fields.

The hazard of flooding, the shrink-swell potential, and restricted permeability limit urban development. Properly designing houses and roads can overcome the shrink-swell potential and restricted permeability, but overcoming the flooding hazard is difficult.

14. Frio-Bosque

Nearly level, very deep, loamy and clayey, well drained soils

This map unit consists of loamy and clayey soils on nearly level bottomland. Typically, Frio soils are on nearly level flats, and Bosque soils are on flats and in slightly convex areas of overbank deposits near streams. The soils formed in loamy and clayey Holocene-age sediments along the Bosque River and local streams, mostly in the western part of the county.

This map unit makes up about 2 percent of the county. It is about 60 percent Frio soils, 13 percent Bosque soils, and 27 percent other soils.

Frio soils typically have a surface layer of brown silty clay. The subsurface layer is very dark grayish brown silty clay. The subsoil is dark brown and brown clay loam. The soils are moderately alkaline throughout.

Bosque soils typically have a surface layer of dark grayish brown clay loam. The subsurface layer is very dark grayish brown clay loam. The subsoil is grayish brown and pale brown clay loam. The soils are moderately alkaline throughout.

Of minor extent in this map unit are Aledo, Lewisville, Sunev, and Tinn soils. Aledo soils are on hillsides bordering flood plains. Lewisville and Sunev soils are on gently sloping colluvial and terrace breaks. Tinn soils are in slight depressions on flood plains.

The soils in this map unit are used mainly as pasture or rangeland. Some areas are used as cropland, and many areas are used mainly for recreation.

The major crops are small grain, forage sorghum, and grain sorghum. These soils have a high available water capacity. Flooding is a problem.

The climax vegetation in areas of rangeland is a tall grass prairie with scattered pecan, cottonwood, and other trees. The main plants are little bluestem, switchgrass, big bluestem, and other grasses and forbs.

Most of the pastures support improved bermudagrass.

The hazard of flooding limits urban development. Because of the proximity to the major steams, mainly the Bosque River, these soils are valuable sites for recreational uses.

Sandy and Loamy Soils Formed in Alluvial Sediments Along the Brazos River; on Stream Terraces and Pleistocene-Age Terraces

This group of general soil map units makes up about 11 percent of McLennan County. Axtell, Bastsil, Desan, Gholson, Minwells, and Riesel soils are dominant in this group. These soils formed in sandy and loamy Pleistocene-age terrace deposits along the Brazos River. The landscape generally is nearly level and gently sloping, but the beveled edges of terraces are strongly sloping. The native vegetation was a savannah with scattered post oak and blackjack oak and an understory of mainly little bluestem, indiangrass, big bluestem, and other native grasses.

Most of the soils in this group have a moderate available water capacity. Some have a clayey subsoil with a high shrink-swell potential. Most are suited to cropland but are used mainly as pasture or rangeland. The major crops are small grain, forage sorghum, peanuts, and truck crops. Improved bermudagrass, common bermudagrass, King Ranch bluestem, and Old World bluestem are adapted pasture plants.

The scenic, nearly level and gently undulating countryside provides desirable homesites. Properly designing houses and roads helps to compensate for the shrinking and swelling of the clayey subsoil. Properly designing septic tank absorption fields helps to overcome restricted permeability. In some areas, the soils are moderately permeable and contamination of ground water is possible.

15. Axtell-Riesel-Minwells

Gently sloping to strongly sloping, very deep, loamy, well drained soils

This map unit consists of loamy soils on upland savannahs. Typically, Axtell soils are on side slopes, Riesel soils are on side slopes and ridges, and Minwells soils are on hillsides and hilltops. The soils formed in Pleistocene-age terrace deposits along the ancient Brazos River.

This map unit makes up about 8 percent of the county. It is about 32 percent Axtell soils, 13 percent Riesel soils, 11 percent Minwells soils, and 44 percent other soils.

Axtell soils typically have a surface layer of grayish brown fine sandy loam. The subsurface layer is very pale brown fine sandy loam. The subsoil is reddish yellow, yellowish red, and gray clay. The soils are strongly acid to slightly acid in the surface layer, the subsurface layer, and the upper part of the subsoil and strongly acid to neutral in the lower part of the subsoil.

Riesel soils typically have a surface layer of dark brown gravelly fine sandy loam. The subsurface layer is brown very gravelly fine sandy loam. The subsoil is red, light yellowish brown, and pale yellow very gravelly clay. The underlying material is pale yellow very gravelly fine sand. The soils are slightly acid or neutral in the surface layer and subsurface layer, moderately acid to slightly alkaline in the subsoil, and slightly alkaline in the underlying material.

Minwells soils typically have a surface layer of brown fine sandy loam. The subsoil is reddish brown and red clay. The underlying material is reddish yellow gravelly sandy clay loam. The soils are slightly acid to slightly alkaline in the surface layer and slightly acid to moderately alkaline in the subsoil.

Of minor extent in this map unit are Branyon, Bremond, Burleson, Chazos, Crockett, Gowen, Heiden, Lamar, Mabank, Ovan, Stephen, Styx, Tinn, and Wilson soils; gravel pits; and Urban land. Branyon, Bremond, Burleson, Mabank, and Wilson soils are mainly on broad flats. Chazos, Styx, and Stephen soils are on hilltops and ridges. Crockett, Heiden, and Lamar soils are on hillsides. Gowen, Ovan, and Tinn soils are on flood plains.

The soils in this map unit are used mainly as pasture. Some areas are used as rangeland, and some are used as cropland.

The major crops are small grain and forage sorghum. A few areas are used for peanuts, vegetables, or truck crops. The available water capacity is moderate. These soils are highly erodible in the more sloping areas.

The climax vegetation in areas of rangeland consists of tall native grasses with scattered oak savannah. The main grasses are little bluestem, switchgrass, and indiangrass. The main trees are post oak and blackjack oak.

Most of the pasture and hayland supports improved bermudagrass. Some areas support King Ranch bluestem. Most of the hay is used as supplemental livestock feed.

Restricted permeability and the shrink-swell potential in the subsoil may limit urban development. Properly designing septic tank absorption fields helps to overcome the restricted permeability.

16. Bastsil-Desan-Gholson

Nearly level to strongly sloping, very deep, sandy and loamy, well drained soils

This map unit consists of sandy and loamy soils on oak savannahs. Typically, Bastsil soils are on nearly level and gently sloping, broad flats, Desan soils are on sandy ridges and side slopes, and Gholson soils are on slope breaks and hillsides. The soils formed in sandy and loamy Pleistocene-age terrace deposits along the ancient Brazos River.

This map unit makes up about 3 percent of the county. It is about 45 percent Bastsil soils, 13 percent Desan soils, 8 percent Gholson soils, and 34 percent other soils.

Bastsil soils typically have a surface layer of reddish brown fine sandy loam. The subsoil is red and reddish yellow sandy clay loam. The underlying material is reddish yellow sandy clay loam. The soils are slightly acid or neutral in the surface layer and moderately acid to slightly alkaline in the subsoil.

Desan soils typically have a surface layer of brown loamy fine sand. The subsurface layer is light brown loamy fine sand. The subsoil is reddish yellow sandy clay loam. The soils are strongly acid to neutral throughout.

Gholson soils typically have a surface layer of brown fine sandy loam. The subsoil is reddish brown and yellowish red sandy clay loam and fine sandy loam. The underlying material is reddish yellow loamy fine sand. The soils are slightly acid or neutral in the surface layer and moderately acid to slightly alkaline in the subsoil.

Of minor extent in this map unit are Axtell, Bremond, Chazos, Dutek, Gowen, Mabank, Minwells, Riesel, and Styx soils; Urban land; and some gravel pits. Axtell, Chazos, Dutek, Minwells, Riesel, and Styx soils are on side slopes and ridges. Bremond and Mabank soils are on broad flats. Gowen soils are on flood plains.

This map unit is used mainly as pasture. Some areas are used as cropland or rangeland. Urban areas are in or near the city of Waco, and gravel pits are throughout the unit.

The major crops are truck crops, vegetables, peanuts, small grain, and forage sorghum. These soils have a high to low available water capacity.

The climax vegetation in areas of rangeland consists tall native grasses with oak savannah. The main plants are little bluestem, indiangrass, and other native grasses or forbs. Trees include post oak and blackjack oak.

Most of the pastures support improved bermudagrass.

These soils are well suited to urban uses. Septic systems can pollute ground water. Part of this unit is in the city of Waco.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given under the heading "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Aledo gravelly clay loam, 2 to 5 percent slopes, is a phase of the Aledo series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes. A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Stephen-Eddy complex, 2 to 5 percent slopes, is an example.

This survey includes *miscellaneous areas*. Such

areas have little or no soil material and support little or no vegetation. Pits, quarry, is an example.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see “Summary of Tables”) give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Soil Descriptions

AdC—Aledo gravelly clay loam, 2 to 5 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: Rolling, benched hillslopes
Landscape position: Ridgetops and hillsides
Slope: Gently sloping, convex
Shape of areas: Irregular or rounded
Size of areas: 10 to 1,200 acres

Typical Profile

Surface layer:
0 to 4 inches—dark grayish brown gravelly clay loam

Subsurface layer:
4 to 12 inches—dark grayish brown very gravelly clay loam

Underlying material:
12 to 28 inches—fractured, indurated limestone bedrock

Soil Properties

Depth: Very shallow or shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderate
Available water capacity: Very low
Root zone: Very shallow or shallow
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Aledo soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The moderately deep Bolar and Denton soils on foot slopes
- The deep Brackett soils on hillsides
- The moderately deep, clayey Crawford soils on hilltops
- The very deep Sunev soils on foot slopes
- Limestone rock outcrops along hillsides

Land Uses

Major land use: Rangeland
Other land uses: Pasture, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
- The very low available water capacity and gravelly surface layer limit the choice of forage plants to those that are drought tolerant, such as kleingrass and improved bermudagrass.
- The very low available water capacity limits the yield capacity.
- The gravelly surface layer makes pasture establishment difficult.

Minor limitations:
- Fence construction is difficult and costly because of the limited depth to bedrock.
- Construction of farm ponds for livestock water is not recommended because of excessive seepage.

Cropland

Major limitations:
- This soil is poorly suited to crops because of the very low available water capacity and the limited depth to bedrock.

Minor limitations:
- None

Rangeland

Major limitations:
- Production may be low during dry periods because of the very low available water capacity and the limited root zone.

Minor limitations:
- Construction of fences is costly because digging in the limestone bedrock is difficult.
- Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
- Effluent filtration is poor and ground-water

contamination is possible in areas used for septic tank absorption fields.

• Excavation of the limestone bedrock is difficult.

• Maintenance of lawn grasses and landscape plants is expensive because of the very low available water capacity and the limited depth to bedrock.

Minor limitations:

• Road excavations are difficult because of the limestone bedrock.

Interpretive Groups

Land capability classification: VIs
Range site: Shallow

AdE—Aledo-Brackett complex, 5 to 20 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: Rolling, benched hillsides
Landscape position: Hillsides and breaks
Slope: Moderately sloping to moderately steep
Shape of areas: Elongated or irregular
Size of areas: 10 to 800 acres

Typical Profile

Aledo soil

Surface layer:
0 to 3 inches—dark grayish brown gravelly clay loam

Subsurface layer:
3 to 11 inches—dark grayish brown very gravelly clay loam

Underlying material:
11 to 20 inches—fractured, indurated limestone bedrock

Brackett soil

Surface layer:
0 to 10 inches—grayish brown gravelly clay loam

Subsoil:
10 to 16 inches—light yellowish brown clay loam

Underlying material:
16 to 60 inches—yellow clay loam interbedded with limestone and claystone

Soil Properties

Depth: Aledo—shallow or very shallow; Brackett—deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderate
Available water capacity: Very low
Root zone: Very shallow to deep
Natural soil fertility: Aledo—high; Brackett—low
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate or low
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Aledo soil and similar inclusions: 55 percent
Brackett soil and similar inclusions: 35 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The moderately deep Bolar soils on foot slopes

• The very deep Sunev soils on foot slopes

• The moderately deep Denton soils on foot slopes

• Limestone rock outcrops

• A moderately deep soil that is similar to the Aledo soil but is more than 20 inches to bedrock; on hillsides

• Small areas of Aledo soils with slopes of less than 5 percent

Land Uses

Major land use: Rangeland
Other land uses: Wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:

• The very low available water capacity and rapid runoff limit the choice of forage plants.

• The gravelly surface layer and the limited depth to bedrock restrict forage production and pasture establishment.

• Most areas are too sloping for the use of mechanical equipment.

• The severe hazard of water erosion is a concern during pasture establishment. Good pasture management is critical in preventing excessive soil loss.

Minor limitations:

• Construction of fences is costly because digging in the limestone bedrock is difficult.

• Construction of farm ponds is not recommended because of seepage, the slope, and rock outcrops.

Cropland

Major limitations:
• The soils are poorly suited to crops because of the very low available water capacity, the limited root zone, and the severe hazard of water erosion.
Minor limitations:
• The soils are poorly suited to cultivation because they are gravelly.

Rangeland

Major limitations:
• These soils produce only moderate amounts of grazeable native forage because of the very low available water capacity.
• Production may be low during dry periods because of the very low available water capacity.
Minor limitations:
• Fences are difficult to construct because of the limited depth to bedrock.
• Construction of farm ponds is not recommended because of seepage.

Urban development

Major limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
• Excavation of the limestone bedrock is difficult.
• Maintenance of lawn grasses and landscape plants is expensive because of the very low available water capacity.
Minor limitations:
• Construction of roads is difficult because of the limestone bedrock.

Interpretive Groups

Land capability classification: Aledo and Brackett soils—VIIs
Range site: Aledo soil—Shallow; Brackett soil—Steep Adobe

AsB—Austin silty clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: Rolling to slightly concave
Landscape position: Foot slopes and broad ridgetops
Slope: Gently sloping, slightly concave
Shape of areas: Irregular or rounded
Size of areas: 5 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown silty clay

Subsurface layer:
6 to 15 inches—dark brown silty clay

Subsoil:
15 to 27 inches—brown silty clay
27 to 30 inches—brown silty clay with about 30 percent chalk fragments

Underlying material:
30 to 36 inches—white, platy chalk

Soil Properties

Depth: Moderately deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderately slow
Available water capacity: Low
Root zone: Moderately deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate or high
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Austin soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The shallow Eddy and Stephen soils along ridgetops and hillsides
• The deep Fairlie soils on foot slopes
• The well drained, deep Heiden and Ferris soils on hillsides
• Small areas of Austin soils with slopes of 3 to 5 percent

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
• The low available water capacity and clayey texture limit the choice of forage plants. Many areas support improved bermudagrass and kleingrass.

Minor limitations:
• Construction of farm ponds is not recommended because of the depth to chalky bedrock and seepage.

Cropland

Major limitations:
• Yields are sometimes low because of the low available water capacity.
Minor limitations:
• Because of the moderate hazard of water erosion, cropping systems that produce large amounts of crop residue are needed to maintain soil tilth, increase the rate of water infiltration, and prevent excessive soil loss.

Rangeland

Major limitations:
• This soil produces only moderate amounts of grazeable native forage because of the low available water capacity.
Minor limitations:
• Construction of farm ponds for livestock water is not recommended because of the depth to bedrock and seepage.

Urban development

Major limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
Minor limitations:
• Shrinking and swelling of the soil can cause buildings, roads, and streets to crack or buckle.
• Excavation of the chalky bedrock is difficult.

Interpretive Groups

Land capability classification: IIIe
Range site: Clay Loam

AuC—Austin-Urban land complex, 1 to 3 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Rolling to slightly concave
Landscape position: Foot slopes and broad ridgetops
Slope: Gently sloping, slightly concave
Shape of areas: Irregular or rounded
Size of areas: 10 to 200 acres

Typical Profile

Austin soil

Surface layer:
0 to 15 inches—dark brown silty clay

Subsoil:
15 to 38 inches—brown silty clay

Underlying material:
38 to 60 inches—white chalk interbedded with chalky marl

Soil Properties

Austin soil

Depth: Moderately deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: Low
Root zone: Moderately deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate or high
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Characteristics of the Urban Land

The Urban land is covered by dwellings, small buildings, apartments, streets, roads, driveways, parking lots, and other structures. Some areas have been cut and shaped for building sites. Because the original soil was used when most cuts and fills were made, the thickness of horizons in the existing profile may vary widely. The basic characteristics of the soil, however, remain the same. In many places imported soil material was used for leveling.

Composition

Austin soil and similar inclusions: 50 percent
Urban land: 40 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The shallow, well drained Eddy and Stephen soils along ridgetops and hillsides
• The deep, moderately well drained Fairlie soils on foot slopes
• The deep, well drained Heiden and Ferris soils on hillsides

Land Uses

Major land use: Urban development
Other land uses: Recreation, pasture

Management Concerns

Pasture

Major limitations:
• Because of urban development, this unit generally is not used as pasture.
Minor limitations:
• None

Cropland

Major limitations:
• Because of urban development, this unit generally is not used as cropland.
Minor limitations:
• The chalky bedrock

Rangeland

Major limitations:
• Because of urban development, this unit generally is not used as rangeland.
Minor limitations:
• None

Urban development

Major limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
Minor limitations:
• Shrinking and swelling of the Austin soil can cause buildings, roads, and streets to crack or buckle.
• Excavation of the chalky bedrock is difficult.
• The low available water capacity adversely affects lawns, gardens, and landscape plants.

Interpretive Groups

• None assigned

AxB—Axtell fine sandy loam, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: None
Landscape position: Side slopes and ridges above drainageways
Slope: Gently sloping, convex
Shape of areas: Elongated or rounded
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown fine sandy loam

Subsurface layer:
4 to 7 inches—very pale brown fine sandy loam

Subsoil:
7 to 36 inches—reddish yellow, yellowish red, and gray clay
36 to 80 inches—light brownish gray, mottled clay loam

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: Moderate
Root zone: Very deep, but slowly penetrated by plant roots
Natural soil fertility: Low
Soil reaction: Strongly acid to slightly acid in the surface layer and subsurface layer, very strongly acid or strongly acid in the upper part of the subsoil, and strongly acid to neutral in the lower part of the subsoil
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Axtell soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Mabank soils in depressions
• The well drained Minwells soils on hillsides and ridges
• The moderately well drained Chazos soils on ridgetops
• The moderately well drained Crockett soils on hillsides
• A soil that is similar to the Axtell soil but has a surface layer that is 10 to 20 inches thick; on foot slopes
• A soil that is similar to the Axtell soil but has a solum that is less than 60 inches thick

Land Uses

Major land use: Pasture
Other land uses: Rangeland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
• The very slow permeability limits the amount of moisture that can infiltrate the soil and be stored for plant use. Much of the annual rainfall is lost as runoff. Many areas support common bermudagrass and improved bermudagrass.
Minor limitations:
• The moderate available water capacity limits the production potential.

Cropland

Major limitations:
• The very slow permeability in the subsoil limits the amount of water infiltrating the soil. Most of the cropland is used for cool-season crops, such as small grain, or fast-growing, early maturing crops, such as forage sorghum.
Minor limitations:
• In wet seasons the very slow permeability can cause the surface to be saturated and can result in erosion.
• The moderate hazard of water erosion limits the kinds of crops that can be grown. Crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
• The very slow permeability limits the amount of water infiltrating the soil, and production may be low in dry years.
Minor limitations:
• The moderate available water capacity limits production.

Urban development

Major limitations:
• The very slow permeability in the subsoil is a severe limitation when a septic system is installed.
• Shrinking and swelling of the soil can cause buildings and roads to crack.
• Proper design and installation can overcome these limitations.
Minor limitations:
• Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity.

Interpretive Groups

Land capability classification: IIIe
Range site: Claypan Savannah

BaA—Bastsil fine sandy loam, 0 to 2 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos and Bosque Rivers
Distinctive landscape features: Nearly level to slightly rolling
Landscape position: Broad flats
Slope: Nearly level or gently sloping
Shape of areas: Elongated along landscape contours
Size of areas: 20 to 300 acres

Typical Profile

Surface layer:
0 to 9 inches—reddish brown fine sandy loam

Subsoil:
9 to 27 inches—red sandy clay loam
27 to 62 inches—reddish yellow sandy clay loam

Underlying material:
62 to 80 inches—reddish yellow sandy clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderate
Available water capacity: High
Root zone: Very deep
Natural soil fertility: Medium
Soil reaction: Slightly acid or neutral in the surface layer and moderately acid to slightly alkaline in the subsoil
Shrink-swell potential: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate

Composition

Bastsil soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The well drained Gholson soils along slope breaks
- The well drained, sandy Dutek soils along the slightly higher hillsides
- The well drained, calcareous Weswood soils along the slightly lower flood plains
- The well drained, slowly permeable Minwells soils along the slightly higher ridges and slopes
- The moderately well drained, very slowly permeable Mabank soils in depressions

Land Uses

Major land use: Pasture
Other land uses: Cropland, recreation, wildlife habitat

Management Concerns

Pasture

Major limitations:
- This soil is well suited to pasture. No major limitations affect this use. Common bermudagrass and improved bermudagrass are the main grasses.

Minor limitations:
- Construction of farm ponds is not recommended because of excessive seepage.

Cropland

Major limitations:
- This soil is well suited to cropland. No major limitations affect this use. The main crops are small grain and forage sorghum. Some areas are planted to vegetables, truck crops, grain sorghum, or corn.

Minor limitations:
- The content of organic matter is low in this soil.
- Because of the moderate hazards of water erosion and wind erosion, crop residue should be left on the surface to prevent excessive soil loss and increase the content of organic matter.

Rangeland

Major limitations:
- This soil is well suited to rangeland. No major limitations affect this use.

Minor limitations:
- Construction of farm ponds for livestock water is not recommended because of excessive seepage.

Urban development

Major limitations:
- Seepage of effluent into ground water is possible in areas used for septic tank absorption fields.
- Many areas are underlain by beds of sand and gravel.

Minor limitations:
- None

Interpretive Groups

Land capability classification: IIe
Range site: Sandy Loam

BaB—Bastsil-Urban land complex, 0 to 2 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos and Bosque Rivers
Distinctive landscape features: Nearly level to slightly rolling
Landscape position: Broad flats
Slope: Nearly level or gently sloping
Shape of areas: Elongated along landscape contours
Size of areas: 20 to 500 acres

Typical Profile

Bastsil soil

Surface layer:
0 to 13 inches—reddish brown fine sandy loam

Subsoil:
13 to 36 inches—yellowish red sandy clay loam
36 to 76 inches—reddish brown sandy clay loam

Underlying material:
76 to 80 inches—yellowish red fine sandy loam

Soil Properties

Bastsil soil

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderate
Available water capacity: High
Root zone: Very deep
Natural soil fertility: Medium
Soil reaction: Slightly acid or neutral in the surface layer and moderately acid to slightly alkaline in the subsoil
Shrink-swell potential: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate

Characteristics of the Urban Land

The Urban land is covered by dwellings, small

buildings, apartments, streets, roads, driveways, parking lots, and other structures. Some areas have been cut and shaped for building sites. Because the original soil was used when most cuts and fills were made, the thickness of horizons in the existing profile may vary widely. The basic characteristics of the soil, however, remain the same. In many places imported soil material was used for leveling.

Composition

Bastsil soil and similar inclusions: 50 percent
Urban land: 40 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

- The well drained Gholson soils along slope breaks
- The well drained, sandy Dutek soils along the slightly higher ridges
- The well drained, calcareous Weswood soils along the slightly lower flood plains
- The well drained, slowly permeable Minwells soils along the slightly higher ridges and slopes
- The moderately well drained Mabank soils in depressions

Land Uses

Major land use: Urban development
Other land uses: Recreation, pasture

Management Concerns

Pasture

Major limitations:
- Because of urban development, this unit generally is not used as pasture.

Minor limitations:
- None

Cropland

Major limitations:
- Because of urban development, this unit generally is not used as cropland.
- The Bastsil soil is well suited to vegetables, garden and landscape plants, and trees.
- The very deep soil, the high available water capacity, and the favorable soil reaction are beneficial to plants.

Minor limitations:
- Because of the moderate hazards of water erosion and wind erosion, organic matter and crop residue should be returned to the surface to protect the soil.

Rangeland

Major limitations:
- Because of urban development, this unit generally is not used as rangeland.

Minor limitations:
- None

Urban development

Major limitations:
- Seepage of effluent into ground water is possible in areas used for septic tank absorption fields.
- Many areas are underlain by beds of sand and gravel.

Minor limitations:
- None

Interpretive Groups

- None assigned

BgB—Bolar gravelly clay loam, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping, concave
Shape of areas: Irregular or elongated
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 4 inches—dark brown gravelly clay loam

Subsurface layer:
4 to 12 inches—dark brown gravelly clay loam

Subsoil:
12 to 20 inches—brown gravelly clay loam
20 to 28 inches—light yellowish brown clay loam

Underlying material:
28 to 40 inches—fractured limestone bedrock interbedded with soft marl

Soil Properties

Depth: Moderately deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderate

Available water capacity: Low
Root zone: Moderately deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Bolar soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The shallow Aledo soils along ridges and hilltops
• The clayey Denton and Purves soils along foot slopes and drainageways
• The clayey Crawford and Oglesby soils along ridgetops
• The very deep Brackett soils along breaks and hillsides
• The shallow Eckrant soils along upland flats

Land Uses

Major land use: Cropland
Other land uses: Rangeland, pasture

Management Concerns

Pasture

Major limitations:
• The low available water capacity limits the choice of plants to those that are drought tolerant or can produce forage during rainy seasons. Many areas support improved bermudagrass and kleingrass.
Minor limitations:
• Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.
• Construction of fences is difficult because of the limestone bedrock.

Cropland

Major limitations:
• The low available water capacity limits the choice of crops to cool-season crops, such as small grain, or short-season, drought-tolerant crop varieties.
Minor limitations:
• Because of the moderate hazard of water erosion, crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.
• The gravelly surface layer is difficult to cultivate.

Rangeland

Major limitations:
• The low available water capacity limits production, especially in dry years.
Minor limitations:
• Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.
• Construction of fences is expensive because digging in the limestone bedrock is difficult.

Urban development

Major limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
• The low available water capacity adds to the cost of maintaining lawns and landscape plants.
Minor limitations:
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.
• Excavation of the limestone bedrock is difficult.

Interpretive Groups

Land capability classification: IIIe
Range site: Clay Loam

Bh—Bosque clay loam, occasionally flooded

Setting

Landform: Flood plains along the Bosque River and local streams
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated and narrow
Size of areas: 20 to 300 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown clay loam

Subsurface layer:
6 to 22 inches—very dark grayish brown clay loam

Subsoil:
22 to 63 inches—grayish brown clay loam
63 to 80 inches—pale brown clay loam

Soil Properties

Depth: Very deep

Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: Occasional, of very brief duration
Runoff: Slow
Permeability: Moderate
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Bosque soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The well drained, clayey Frio soils on flood plains
- The moderately well drained, clayey Tinn soils in slight depressions on flood plains
- The well drained Sunev and Lewisville soils on hillsides bordering flood plains

Land Uses

Major land use: Pasture (fig. 8)
Other land uses: Cropland, rangeland, recreation

Management Concerns

Pasture

Major limitations:
- The soil is flooded about once every 2 to 10 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.

Minor limitations:
- Construction of farm ponds is not recommended because of seepage.

Cropland

Major limitations:
- Crop losses can occur because of flooding. Some areas are used for small grain, forage sorghum, or other crops.

Minor limitations:
- The available water capacity is high, but crop stress can occur on this well drained soil during dry periods.

Rangeland

Major limitations:
- This soil is well suited to rangeland, but flooding may be a problem in some years.

Minor limitations:
- Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
- Flooding is a severe hazard on sites for streets, houses, or other urban structures.

Minor limitations:
- Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.

Interpretive Groups

Land capability classification: IIw
Range site: Loamy Bottomland

BnA—Branyon clay, 0 to 1 percent slopes

Setting

Landform: Pleistocene-age terraces along local streams
Distinctive landscape features: Flat
Landscape position: Broad flats
Slope: Nearly level
Shape of areas: Rounded or elongated
Size of areas: 10 to 1,000 acres

Typical Profile

Surface layer:
0 to 4 inches—very dark gray clay

Subsoil:
4 to 56 inches—very dark gray clay
56 to 80 inches—dark grayish brown clay
80 to 90 inches—pale brown clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Neutral to moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Branyon soil and similar inclusions: 90 percent
Contrasting inclusions: 10 percent

Figure 8.—Round bales of coastal bermudagrass hay on Bosque clay loam, occasionally flooded.

Contrasting Inclusions

- The noncalcareous Burleson soils on broad flats
- Wilson soils, which have a surface layer of clay loam and are on broad flats
- The well drained Krum and Lewisville soils on flats and breaks
- Small areas of Branyon soils with slopes of more than 1 percent
- The moderately well drained Slidell soils in the slightly higher positions

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- The very slow permeability can cause temporary wetness during wet periods.
- Fence maintenance is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
- None

Minor limitations:
- The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
- Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
- None

Minor limitations:
• The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
• The very slow permeability can cause septic systems to work improperly.
• Establishing lawns and landscape plants is difficult on this clayey soil.
• Shallow excavations sometimes cave in.
Minor limitations:
• The medium runoff and very slow permeability can cause water to accumulate for short periods.

Interpretive Groups

Land capability classification: IIw
Range site: Blackland

BnB—Branyon clay, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age terraces along local streams
Distinctive landscape features: None
Landscape position: Slopes along broad flats
Slope: Gently sloping
Shape of areas: Elongated
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—very dark gray clay

Subsoil:
4 to 68 inches—very dark gray clay
68 to 80 inches—dark grayish brown clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Branyon soil and similar inclusions: 90 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The noncalcareous Burleson soils on broad flats
• Wilson soils, which have a surface layer of clay loam and are on broad flats
• The well drained Krum and Lewisville soils in the slightly higher positions
• The moderately well drained Houston Black soils along hillsides
• The moderately well drained Slidell soils in the slightly higher positions

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness during wet periods.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
• Because of the moderate hazard of water erosion, management of crop residue, terraces, or grassed waterways may be needed to prevent excessive soil loss.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
- Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
- The very slow permeability can cause septic systems to work improperly.
- Establishing lawns and landscape plants is difficult on this clayey soil.
- Shallow excavations sometimes cave in.

Minor limitations:
- The medium runoff and very slow permeability can cause water to accumulate for short periods.

Interpretive Groups

Land capability classification: IIe
Range site: Blackland

BrB—Bremond loam, 0 to 2 percent slopes

Setting

Landform: Stream terraces of Pleistocene age
Distinctive landscape features: None
Landscape position: Broad flats
Slope: Nearly level or gently sloping
Shape of areas: Irregular or elongated
Size of areas: 10 to 100 acres

Typical Profile

Surface layer:
0 to 5 inches—light yellowish brown loam

Subsoil:
5 to 24 inches—brown clay
24 to 37 inches—dark yellowish brown clay
37 to 80 inches—brown and yellowish brown clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: Moderate
Root zone: Very deep, but slowly penetrated by plant roots
Natural soil fertility: Medium
Soil reaction: Moderately acid to neutral in the surface layer and moderately acid to moderately alkaline in the subsoil
Shrink-swell potential: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Bremond soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The moderately well drained Mabank and Wilson soils in slight depressions
- The moderately well drained Axtell soils on the slightly higher ridges
- The moderately well drained Crockett and well drained Lamar soils on hillsides

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, recreation, urban development

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- The very slow permeability in the subsoil limits water infiltration and root penetration.
- The moderate available water capacity limits the production of forage.

Cropland

Major limitations:
- None

Minor limitations:
- The very slow permeability in the subsoil limits the penetration of water and plant roots.
- The medium natural fertility and a low content of organic matter cause the soil to be crusty and difficult to cultivate when dry.
- The moderate available water capacity limits crop yields.
- In wet years the very slow permeability and slow runoff can cause temporary wetness.

Rangeland

Major limitations:
- None

Minor limitations:
- The very slow permeability limits the penetration of water and plant roots.

• The moderate available water capacity limits production.

Urban development

Major limitations:
• The very slow permeability and slow runoff can cause septic systems to fail in wet periods.
• Shrinking and swelling of the soil can cause houses, streets, roads, and sidewalks to crack or buckle.
Minor limitations:
• The slow runoff and very slow permeability can cause water to accumulate on yards and streets for short periods.

Interpretive Groups

Land capability classification: IIIe
Range site: Claypan Prairie

BuA—Burleson clay, 0 to 1 percent slopes

Setting

Landform: Stream terraces of Pleistocene age
Distinctive landscape features: Flat
Landscape position: Broad flats
Slope: Nearly level
Shape of areas: Rounded or elongated
Size of areas: 10 to 500 acres

Typical Profile

Surface layer:
0 to 24 inches—dark gray clay

Subsoil:
24 to 40 inches—dark gray clay
40 to 80 inches—gray and grayish brown clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Slightly acid to moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Burleson soil and similar inclusions: 90 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The calcareous Branyon soils on broad flats
• The moderately well drained Wilson soils on broad flats
• The well drained Krum and Lewisville soils on flats and breaks
• Small areas of the well drained Lamar soils near landscape breaks

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness during wet periods.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
• The very slow permeability can cause septic systems to work improperly.

• Establishing lawns and landscape plants is difficult on this clayey soil.
• Shallow excavations sometimes cave in.
Minor limitations:
• The slow runoff and very slow permeability can cause water to accumulate for short periods.

Interpretive Groups

Land capability classification: IIw
Range site: Blackland

CaB—Chazos loamy fine sand, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: None
Landscape position: Side slopes and ridges above drainageways
Slope: Gently sloping, convex
Shape of areas: Elongated or rounded
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—dark grayish brown loamy fine sand

Subsurface layer:
8 to 15 inches—light yellowish brown loamy fine sand

Subsoil:
15 to 27 inches—light yellowish brown and yellowish brown clay
27 to 40 inches—pale brown clay
40 to 55 inches—gray sandy clay
55 to 80 inches—very pale brown clay loam

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Slow
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Moderately acid to neutral in the surface layer and subsurface layer and moderately acid to slightly alkaline in the subsoil
Shrink-swell potential: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Moderate

Composition

Chazos soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Mabank soils in depressions
• The well drained Minwells soils on hillsides and ridges
• The moderately well drained Axtell and Crockett soils on hillsides

Land Uses

Major land use: Pasture
Other land uses: Rangeland,cropland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The slow permeability limits the amount of moisture that can infiltrate the soil and be stored for plant use. Much of the annual rainfall is lost as runoff. Many areas support common bermudagrass and improved bermudagrass.
• The moderate available water capacity limits the production potential.

Cropland

Major limitations:
• None
Minor limitations:
• The slow permeability in the subsoil limits the amount of water infiltrating the soil. Most of the cropland is used for cool-season crops, such as small grain, or fast-growing, early maturing crops, such as forage sorghum.
• The moderate hazards of water erosion and wind erosion limit the kinds of crops that can be grown. Crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production.
• The slow permeability limits the amount of water infiltrating the soil, and production may be low in

dry years. The climax vegetation was post oak savannah.

Urban development

Major limitations:
• None
Minor limitations:
• Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity.
• The slow permeability in the subsoil can cause septic systems to fail in wet years.
• Shrinking and swelling of the soil can cause buildings and roads to crack.
• Proper design and installation can overcome these limitations.

Interpretive Groups

Land capability classification: IIe
Range site: Sandy Loam

CfB—Crawford clay, 0 to 2 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Broad hilltops
Slope: Nearly level or gently sloping, slightly convex
Shape of areas: Irregular or rounded
Size of areas: 10 to 500 acres

Typical Profile

Surface layer:
0 to 11 inches—dark reddish gray clay

Subsoil:
11 to 27 inches—reddish brown clay
27 to 34 inches—reddish brown gravelly silty clay
34 to 38 inches—yellowish red gravelly silty clay

Underlying material:
38 to 48 inches—fractured limestone bedrock with reddish brown silty clay along fractures

Soil Properties

Depth: Moderately deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: Low
Root zone: Moderately deep
Natural soil fertility: High
Soil reaction: Slightly acid to moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Crawford soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The shallow Aledo soils along ridges and hilltops
• The shallow Purves soils along foot slopes and drainageways
• The shallow Oglesby soils along ridgetops
• The light colored Brackett soils along breaks and hillsides
• The shallow Eckrant soils along upland flats
• The darker Denton soils along foot slopes

Land Uses

Major land use: Cropland
Other land uses: Rangeland, pasture

Management Concerns

Pasture

Major limitations:
• The low available water capacity limits the choice of plants to those that are drought tolerant or can produce forage during rainy seasons. Many areas support improved bermudagrass and kleingrass.
Minor limitations:
• Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.
• Construction of fences is difficult because of the limestone bedrock.

Cropland

Major limitations:
• The low available water capacity limits the choice of crops to cool-season crops, such as small grain, or short-season, drought-tolerant crop varieties.
Minor limitations:
• Because of the moderate hazard of water erosion, crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.
• The very slow permeability limits the penetration of water and plant roots.

Rangeland

Major limitations:
• The low available water capacity limits production, especially in dry years.
Minor limitations:
• Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.
• Construction of fences is expensive because digging in the limestone bedrock is difficult.

Urban development

Major limitations:
• The very slow permeability and the depth to bedrock can cause septic systems to fail.
• The low available water capacity adds to the cost of maintaining lawns and landscape plants.
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.
Minor limitations:
• Excavation of the limestone bedrock is difficult.

Interpretive Groups

Land capability classification: IIe
Range site: Deep Redland

CrB—Crockett loam, 3 to 5 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Hillsides
Slope: Gently sloping, convex
Shape of areas: Elongated along slope breaks
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 9 inches—pale brown loam

Subsoil:
9 to 36 inches—brown and yellowish brown clay
36 to 55 inches—light brownish gray and grayish brown clay

Underlying material:
55 to 80 inches—light yellowish brown clay

Soil Properties

Depth: Deep to shale
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: Moderate
Root zone: Deep, but slowly penetrated by plant roots
Natural soil fertility: Medium
Soil reaction: Moderately acid to neutral in the surface layer and moderately acid to moderately alkaline in the subsoil
Shrink-swell potential: High
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Crockett soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The clayey Heiden and Ferris soils along hillsides
• The well drained Lamar soils along hillsides
• The moderately well drained Wilson and Mabank soils in depressions
• The moderately well drained Axtell soils along hillsides

Land Uses

Major land use: Pasture
Other land uses: Rangeland, cropland, recreation

Management Concerns

Pasture

Major limitations:
• The very slow permeability limits the amount of moisture that can infiltrate the soil and be stored for plant use. Much of the annual rainfall is lost as runoff. Many areas support common bermudagrass and improved bermudagrass.
Minor limitations:
• The moderate available water capacity limits the production potential.

Cropland

Major limitations:
• The very slow permeability in the subsoil limits the amount of water infiltrating the soil. Most of the cropland is used for cool-season crops, such as small grain, or fast-growing, early maturing crops, such as forage sorghum.
Minor limitations:
• In wet seasons the very slow permeability can cause the surface to be saturated and can result in erosion.
• The severe hazard of water erosion limits the kinds of crops that can be grown. Crop residue should be

left on the surface to prevent excessive soil loss and maintain the content of organic matter.
• The moderate available water capacity limits production.

Rangeland

Major limitations:
• The very slow permeability limits the amount of water infiltrating the soil, and production may be low in dry years.
Minor limitations:
• The moderate available water capacity limits production.

Urban development

Major limitations:
• The very slow permeability in the subsoil could cause a septic system to fail.
• Shrinking and swelling of the soil can cause buildings and roads to crack.
• Proper design and installation can overcome these limitations.
Minor limitations:
• Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity.

Interpretive Groups

Land capability classification: IVe
Range site: Claypan Prairie

DeB—Denton silty clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping, concave
Shape of areas: Irregular or elongated
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 5 inches—dark grayish brown silty clay

Subsurface layer:
5 to 14 inches—dark grayish brown silty clay

Subsoil:
14 to 22 inches—brown silty clay loam
22 to 36 inches—very pale brown silty clay loam
36 to 52 inches—brownish yellow gravelly silty clay loam

Underlying material:
52 to 60 inches—fractured limestone bedrock interbedded with soft marl

Soil Properties

Depth: Deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Slow
Available water capacity: Moderate
Root zone: Moderately deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Denton soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The shallow Aledo soils along ridges and hilltops
• The clayey Purves soils along foot slopes and drainageways
• The clayey Crawford and Oglesby soils along ridgetops
• The light colored Brackett soils along breaks and hillsides
• The shallow Eckrant soils along upland flats
• The loamy Bolar soils along foot slopes

Land Uses

Major land use: Cropland
Other land uses: Rangeland, pasture

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits the choice of plants to those that are drought tolerant or can produce forage during rainy seasons. Many areas support improved bermudagrass and kleingrass.
• Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.

• Maintenance of fences is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits the choice of crops to cool-season crops, such as small grain, short-season, and drought-tolerant crop varieties.
• Because of the moderate hazard of water erosion, crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
• None
Minor limitations:
• The low available water capacity limits production, especially in dry years.
• Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Urban development

Major limitations:
• None
Minor limitations:
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.
• Excavation of the limestone bedrock is difficult.
• The slow permeability can sometimes cause septic systems to fail.
• The moderate available water capacity can add to the cost of maintaining lawns and landscape plants.

Interpretive Groups

Land capability classification: IIe
Range site: Clay Loam

DsC—Desan loamy fine sand, 1 to 5 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: Mounded
Landscape position: Hillsides
Slope: Gently sloping
Shape of areas: Rounded or irregular
Size of areas: 20 to 300 acres

Typical Profile

Surface layer:
0 to 7 inches—brown loamy fine sand

Subsurface layer:
7 to 65 inches—light brown loamy fine sand

Subsoil:
65 to 80 inches—reddish yellow sandy clay loam

Soil Properties

Depth: Very deep
Drainage class: Somewhat excessively drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Very slow
Permeability: Moderate
Available water capacity: Low
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Strongly acid to neutral
Shrink-swell potential: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Severe

Composition

Desan soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained Bastsil and Dutek soils along ridges
• The moderately well drained Chazos soils along foot slopes and broad ridges
• The moderately well drained Mabank soils in depressions

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland

Management Concerns

Pasture

Major limitations:
• The low available water capacity limits production and restricts the choice of plants to those that are drought tolerant. Many areas support improved bermudagrass.
Minor limitations:
• Construction of farm ponds is not recommended because of excessive seepage.

Cropland

Major limitations:
• The low available water capacity limits production. The major crops are peanuts and truck crops.
Minor limitations:
• Because of the hazards of water erosion and wind erosion, crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
• The low available water capacity limits production in dry years.
Minor limitations:
• Construction of farm ponds is not recommended because of excessive seepage.

Wildlife habitat

Major limitations:
• None
Minor limitations:
• None

Urban development

Major limitations:
• Because of the low available water capacity and the sandy surface layer, establishing and maintaining lawns and landscape plants may be difficult.
• Seepage of effluent through the moderately permeable subsoil and into ground water is possible in areas used for septic tank absorption fields.
Minor limitations:
• None

Interpretive Groups

Land capability classification: IIIe
Range site: Deep Sand

DuB—Dutek loamy fine sand, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: Mounded
Landscape position: Hillsides
Slope: Gently sloping
Shape of areas: Rounded or irregular
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 8 inches—brown loamy fine sand

Subsurface layer:
8 to 30 inches—reddish yellow loamy fine sand

Subsoil:
30 to 60 inches—yellowish red sandy clay loam

Underlying material:
60 to 80 inches—reddish yellow loamy fine sand

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Moderate
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Moderately acid to neutral in the surface layer and subsurface layer and very strongly acid to slightly acid in the subsoil
Shrink-swell potential: Very low
Hazard of water erosion: Moderate
Hazard of wind erosion: Severe

Composition

Dutek soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained Bastsil soils along ridges
• The moderately well drained Chazos soils along foot slopes and broad ridges
• The moderately well drained Mabank soils in depressions
• The somewhat excessively drained Desan soils along ridges

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production and restricts the choice of plants to those

that are drought tolerant. Many areas support improved bermudagrass.
• Construction of farm ponds is not recommended because of excessive seepage.

Cropland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production. The major crops are peanuts and truck crops.
• Because of the hazards of water erosion and wind erosion, crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production in dry years.
• Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
• Seepage of effluent through the moderately permeable subsoil and into ground water is possible in areas used for septic tank absorption fields.
Minor limitations:
• Because of the moderate available water capacity and the sandy surface layer, establishing and maintaining lawns and landscape plants may be difficult.

Interpretive Groups

Land capability classification: IIIs
Range site: Sandy

EcB—Eckrant cobbly silty clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: Broad hilltops and breaks
Landscape position: Ridgetops and hillsides
Slope: Gently sloping, convex
Shape of areas: Elongated
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 4 inches—dark brown cobbly silty clay (fig. 9)
4 to 15 inches—dark brown very cobbly silty clay

Underlying material:
15 to 40 inches—indurated limestone bedrock with coarse fractures

Soil Properties

Depth: Very shallow or shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderately slow
Available water capacity: Very low
Root zone: Very shallow or shallow
Natural soil fertility: High
Soil reaction: Slightly alkaline or moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Eckrant soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately deep Bolar and deep Denton soils on foot slopes
• The light colored Brackett soils on hillsides
• The moderately deep, clayey Crawford soils on hilltops
• The very deep Sunev soils on foot slopes
• Limestone rock outcrops along hillsides
• The well drained Aledo soils on rolling, benched hills

Land Uses

Major land use: Rangeland
Other land uses: Pasture, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
• The very low available water capacity and cobbly surface layer limit the choice of forage plants to those that are drought tolerant.
• The very low available water capacity limits the yield capacity.

• The cobbly surface layer makes pasture establishment difficult.

Minor limitations:

• Fence construction is difficult and costly because of the limited depth to bedrock.

• Construction of farm ponds for livestock water is not recommended because of excessive seepage.

Cropland

Major limitations:

• This soil is not suited to crops because of the very low available water capacity and the limited depth to bedrock.

Rangeland

Major limitations:

• Production may be low during dry periods because of the very low available water capacity and the limited root zone.

Minor limitations:

• Construction of fences is costly because digging in the limestone bedrock is difficult.

• Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:

• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.

• Excavation of the limestone bedrock is difficult.

• Maintenance of lawn grasses and landscape plants is expensive because of the very low available water capacity and the limited depth to bedrock.

Figure 9.—Livestock water facility on Eckrant cobbly silty clay, 1 to 3 percent slopes. Cobbles and stones may cover as much as 35 percent of the soil surface.

Minor limitations:
• Road excavations are difficult because of the limestone bedrock.

Interpretive Groups

Land capability classification: VIIs
Range site: Low Stony Hill

EdD—Eddy gravelly clay loam, 3 to 15 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Chalky hillsides
Landscape position: Hillsides and ridges
Slope: Gently sloping to moderately steep
Shape of areas: Rounded or irregular
Size of areas: 50 to 2,500 acres

Typical Profile

Surface layer:
0 to 4 inches—brown gravelly clay loam

Subsoil:
4 to 8 inches—brown very gravelly clay loam

Underlying material:
8 to 20 inches—white, chalky limestone interbedded with chalky marl

Soil Properties

Depth: Shallow or very shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: Very low
Root zone: Shallow or very shallow
Natural soil fertility: Medium
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Eddy soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately deep Austin soils along foot slopes
• The darker colored Stephen soils along ridges and side slopes
• The deep Fairlie soils along foot slopes
• The very deep Houston Black and deep Heiden soils along foot slopes
• Areas of Eddy soils and rock outcrop with slopes of 15 to 50 percent

Land Uses

Major land use: Rangeland
Other land uses: Pasture, recreation

Management Concerns

Pasture

Major limitations:
• The very low available water capacity and the gravelly surface layer limit forage production. Some areas support drought-tolerant species, such as King Ranch bluestem and kleingrass.
Minor limitations:
• Construction of farm ponds is not recommended because of the depth to bedrock and seepage.
• Construction of fences is expensive and difficult because of the chalky bedrock.

Cropland

Major limitations:
• This soil is not suited to cropland because of the depth to bedrock and the very low available water capacity.
• This shallow or very shallow soil is very easily eroded if cultivated.
Minor limitations:
• This soil is difficult to cultivate because it is gravelly.

Rangeland

Major limitations:
• Production may be low in dry years because of the very low available water capacity and the limited root zone.
Minor limitations:
• Construction of fences is expensive because digging in the chalky bedrock is difficult.
• Farm ponds are not recommended because of excessive seepage and the depth to bedrock.

Urban development

Major limitations:
• Septic systems are difficult to install in the chalky bedrock.
• Establishment of lawns, road construction, and excavations are difficult because of the chalky bedrock.
• The very low available water capacity makes maintenance of yards and plants expensive.

Minor limitations:
• Road and street excavations are difficult because of the chalky bedrock.
• Construction is difficult on the moderately steep slopes.

Interpretive Groups

Land capability classification: VIe
Range site: Chalky Ridge

EeD—Eddy-Urban land complex, 3 to 15 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Chalky hillsides
Landscape position: Hillsides and ridges
Slope: Gently sloping to moderately steep
Shape of areas: Irregular or rounded
Size of areas: 50 to 500 acres

Typical Profile

Eddy soil

Surface layer:
0 to 4 inches—brown gravelly clay loam

Subsoil:
4 to 10 inches—brown very gravelly clay loam

Underlying material:
10 to 20 inches—white chalk interbedded with chalky marl

Soil Properties

Eddy soil

Depth: Shallow or very shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: Very low
Root zone: Shallow or very shallow
Natural soil fertility: Medium
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Characteristics of the Urban Land

The Urban land is covered by dwellings, small buildings, apartments, streets, roads, driveways, parking lots, and other structures. Some areas have been cut and shaped for building sites. Because the original soil was used when most cuts and fills were made, the thickness of horizons in the existing profile may vary widely. The basic characteristics of the soil, however, remain the same. In many places imported soil material was used for leveling.

Composition

Eddy soil and similar inclusions: 50 percent
Urban land and similar inclusions: 40 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The shallow, well drained Stephen soils along ridgetops and hillsides
• The deep, moderately well drained Fairlie soils on foot slopes
• The deep, well drained Heiden and Ferris soils on hillsides
• The moderately deep, well drained Austin soils on foot slopes
• Areas of Eddy soils and rock outcrop with slopes of 15 to 50 percent

Land Uses

Major land use: Urban development
Other land uses: Recreation, pasture

Management Concerns

Pasture

Major limitations:
• Because of urban development, this unit generally is not used as pasture.
• The very low available water capacity limits production.
Minor limitations:
• None

Cropland

Major limitations:
• Because of urban development, this unit generally is not used as cropland.
Minor limitations:
• None

Rangeland

Major limitations:
• Because of urban development, this unit generally is not used as rangeland.
Minor limitations:
• None

Urban development

Major limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
• The very low available water capacity adversely affects lawns, gardens, and landscape plants.
Minor limitations:
• Excavation of the chalky bedrock is difficult.
• Construction is difficult on the moderately steep slopes.

Interpretive Groups

• None assigned

EsE—Ellis clay, 8 to 20 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Steep shaly hills
Landscape position: Hillsides
Slope: Strongly sloping or moderately steep
Shape of areas: Elongated or irregular
Size of areas: 30 to 300 acres

Typical Profile

Surface layer:
0 to 4 inches—grayish brown clay

Subsoil:
4 to 14 inches—pale yellow clay
14 to 28 inches—very pale brown clay

Underlying material:
28 to 60 inches—olive gray, yellow, and dark gray platy shale

Soil Properties

Depth: Moderately deep to shale
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: Low
Root zone: Moderately deep
Natural soil fertility: Medium
Soil reaction: Neutral to moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Ellis soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Crockett soils on ridgetops and foot slopes
• The very deep Lott and Lamar soils along the lower hillsides
• The loamy McLennan soils along hillsides
• The deep Heiden and Ferris soils along foot slopes
• Many uncrossable gullies and areas where the topsoil has been removed by erosion

Land Uses

Major land use: Rangeland
Other land uses: Pasture, recreation

Management Concerns

Pasture

Major limitations:
• Establishment of pasture species is difficult on this highly erodible soil.
Minor limitations:
• The low available water capacity limits production.
• The rapid runoff and the very slow permeability make it difficult for water to infiltrate the soil.

Cropland

Major limitations:
• This soil is poorly suited to cropland because of the slope and the severe hazard of water erosion.

Rangeland

Major limitations:
• Production may be low during dry periods because of the low available water capacity.
Minor limitations:
• Weeds and brush are difficult to control on the moderately steep slopes.

Urban development

Major limitations:
• The very slow permeability and the slope can cause septic systems to fail.
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.
Minor limitations:
• Maintenance of lawns and grasses is difficult on this clayey, strongly sloping or moderately steep soil.

Interpretive Groups

Land capability classification: VIe
Range site: Eroded Blackland

FaB—Fairlie clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping, slightly concave
Shape of areas: Irregular or rounded
Size of areas: 5 to 400 acres

Typical Profile

Surface layer:
0 to 5 inches—very dark gray clay

Subsurface layer:
5 to 14 inches—very dark gray clay

Subsoil:
14 to 32 inches—very dark gray clay
32 to 42 inches—grayish brown clay

Underlying material:
42 to 60 inches—white, platy chalk interbedded with chalky marl

Soil Properties

Depth: Deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Very slow
Available water capacity: Moderate
Root zone: Deep
Natural soil fertility: High
Soil reaction: Slightly alkaline or moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Fairlie soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The shallow Eddy and Stephen soils along ridgetops and hillsides
• The moderately deep Austin soils on foot slopes
• The well drained, deep Heiden and Ferris soils on hillsides
• Small areas of Fairlie soils with slopes of 3 to 5 percent

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The moderate available water capacity and clayey texture limit the choice of forage plants. Many areas support improved bermudagrass and kleingrass.
• Construction of farm ponds is not recommended because of the depth to chalky bedrock and seepage.

Cropland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity and very slow permeability sometimes limit yields.
• Because of the moderate hazard of water erosion, cropping systems that produce large amounts of crop residue are needed to maintain soil tilth, increase the rate of water infiltration, and prevent excessive soil loss.

Rangeland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production.
• Construction of farm ponds for livestock water is not recommended because of the depth to bedrock and seepage.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause buildings, roads, and streets to crack or buckle.
• The very slow permeability may cause septic systems to fail in wet seasons.
Minor limitations:
• Excavation of the chalky bedrock is difficult.

Interpretive Groups

Land capability classification: IIe

Range site: Blackland

FbB—Fairlie-Urban land complex, 1 to 3 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping, slightly concave
Shape of areas: Irregular or rounded
Size of areas: 10 to 200 acres

Typical Profile

Fairlie soil

Surface layer:
0 to 5 inches—very dark gray clay

Subsurface layer:
5 to 14 inches—very dark gray clay

Subsoil:
14 to 32 inches—very dark gray clay
32 to 45 inches—grayish brown clay

Underlying material:
45 to 60 inches—white chalk interbedded with chalky marl

Soil Properties

Fairlie soil

Depth: Deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: Moderate
Root zone: Deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Characteristics of the Urban Land

The Urban land is covered by dwellings, small buildings, apartments, streets, roads, driveways, parking lots, and other structures. Some areas have been cut and shaped for building sites. Because the original soil was used when most cuts and fills were made, the thickness of horizons in the existing profile may vary widely. The basic characteristics of the soil, however, remain the same. In many places imported soil material was used for leveling.

Composition

Fairlie soil and similar inclusions: 50 percent
Urban land and similar inclusions: 40 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

- The shallow, well drained Eddy and Stephen soils along ridgetops and hillsides
- The moderately deep, well drained Austin soils on foot slopes
- The deep, well drained Heiden and Ferris soils on hillsides

Land Uses

Major land use: Urban development
Other land uses: Recreation, pasture

Management Concerns

Pasture

Major limitations:
- Because of urban development, this unit generally is not used as pasture.

Minor limitations:
- None

Cropland

Major limitations:
- Because of urban development, this unit generally is not used as cropland.

Minor limitations:
- None

Rangeland

Major limitations:
- Because of urban development, this unit generally is not used as rangeland.

Minor limitations:
- None

Urban development

Major limitations:
- The very slow permeability can cause septic systems to fail in wet seasons.
- Shrinking and swelling of the soil can cause buildings, roads, and streets to crack or buckle.

Minor limitations:
- Excavation of the chalky bedrock is difficult.
- The moderate available water capacity adversely affects lawns, gardens, and landscape plants.

Interpretive Groups

• None assigned

FeE2—Ferris clay, 8 to 15 percent slopes, eroded

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Eroded hillsides with many small rills and gullies; 25 to 50 percent of the original topsoil has been removed by water erosion in most areas.
Landscape position: Hillsides
Slope: Strongly sloping or moderately steep
Shape of areas: Elongated or irregular
Size of areas: 30 to 300 acres

Typical Profile

Surface layer:
0 to 6 inches—light brownish gray clay

Subsoil:
6 to 45 inches—light yellowish brown clay

Underlying material:
45 to 60 inches—yellow and gray shale with clay texture

Soil Properties

Depth: Deep to shale
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: Moderate
Root zone: Deep
Natural soil fertility: Medium
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Ferris soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Crockett soils on ridgetops and foot slopes
• The very deep Lott and Lamar soils along the lower hillsides
• The loamy McLennan soils along hillsides
• The deep Heiden and very deep Houston Black soils along foot slopes and ridgetops
• Many uncrossable gullies and areas where the topsoil has been removed by erosion

Land Uses

Major land use: Rangeland
Other land uses: Pasture, recreation

Management Concerns

Pasture

Major limitations:
• Establishment of pasture species is difficult on this highly erodible soil.
Minor limitations:
• The moderate available water capacity may limit forage production in dry years.
• Maintenance of fences is costly because of shrinking and swelling of the soil.
• The rapid runoff and the very slow permeability make it difficult for water to infiltrate the soil.

Cropland

Major limitations:
• This soil is poorly suited to cropland because of the slope and the severe hazard of water erosion.

Rangeland

Major limitations:
• None
Minor limitations:
• Production may be low in dry years because of the moderate available water capacity.
• Weeds and brush are difficult to control on the moderately steep slopes.
• Maintenance of fences is difficult because of shrinking and swelling of the soil.

Urban development

Major limitations:
• The very slow permeability and the slope can cause septic systems to fail.
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.
Minor limitations:
• Establishment and maintenance of lawns and grasses can be difficult on this clayey, strongly sloping or moderately steep soil.

Interpretive Groups

Land capability classification: VIe
Range site: Eroded Blackland

Fr—Frio silty clay, occasionally flooded

Setting

Landform: Holocene-age flood plains along the Bosque River and local streams
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated and narrow
Size of areas: 20 to 300 acres

Typical Profile

Surface layer:
0 to 4 inches—brown silty clay

Subsurface layer:
4 to 24 inches—very dark grayish brown silty clay

Subsoil:
24 to 42 inches—dark brown clay loam
42 to 80 inches—brown clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: Occasional, of very brief duration
Runoff: Slow
Permeability: Moderately slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Frio soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained, loamy Bosque soils on flood plains
• The moderately well drained, clayey Tinn soils in slight depressions on flood plains
• The well drained Sunev and Lewisville soils on hillsides bordering flood plains
• Along Tonk Creek, north of Crawford, a soil that is similar to the Frio soil but is underlain by limestone bedrock at a depth of 40 to 60 inches

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, recreation

Management Concerns

Pasture

Major limitations:
• The soil is flooded about once every 2 to 10 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.
Minor limitations:
• None

Cropland

Major limitations:
• Crop losses can occur because of flooding. Some areas are used for corn, cotton, grain sorghum, forage sorghum, or other crops.
Minor limitations:
• None

Rangeland

Major limitations:
• This soil is well suited to rangeland, but flooding may be a problem in some years.
Minor limitations:
• None

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
Minor limitations:
• None

Interpretive Groups

Land capability classification: IIw
Range site: Loamy Bottomland

Ga—Gaddy loamy fine sand, frequently flooded

Setting

Landform: Holocene-age flood plains along the Brazos River
Distinctive landscape features: Benched riverbanks
Landscape position: Riverbanks
Slope: Nearly level or gently sloping
Shape of areas: Elongated
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—brown loamy fine sand

Underlying material:
8 to 80 inches—reddish yellow and very pale brown loamy fine sand with thin strata of fine sandy loam, very fine sandy loam, and silt loam

Soil Properties

Depth: Very deep
Drainage class: Somewhat excessively drained
Water table: None within a depth of 6 feet
Flooding: Frequent, of very brief or brief duration
Runoff: Rapid
Permeability: Rapid
Available water capacity: Low
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Moderate

Composition

Gaddy soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The loamy Weswood and Yahola soils in the slightly higher positions
- The clayey Ships soils on the slightly higher flats

Land Uses

Major land use: Rangeland
Other land uses: Pasture, recreation, urban development

Management Concerns

Pasture

Major limitations:
- The low available water capacity may limit the selection of forage species to drought-tolerant plants. Many areas support improved bermudagrass.
- This soil is flooded at least once every 1 to 2 years. Floods can destroy fences, cause erosion, and deposit sediment on established pastures.

Minor limitations:
- Construction of farm ponds is not recommended because of seepage.

Cropland

Major limitations:
- This soil is poorly suited to cropland because of frequent flooding.
- The low available water capacity limits yields.

Minor limitations:
- None

Rangeland

Major limitations:
- This soil is poorly suited to cropland because of frequent flooding.
- The low available water capacity limits production.

Minor limitations:
- Construction of farm ponds is not recommended because of seepage.

Urban development

Major limitations:
- Frequent flooding can damage streets, roads, houses, and other urban structures.
- This sandy soil is a poor filter for the effluent from septic systems. As a result, the effluent can contaminate ground water.

Minor limitations:
- Lawns and landscape plants require frequent watering on this sandy soil.

Interpretive Groups

Land capability classification: Vw
Range site: Sandy Bottomland

GhD—Gholson fine sandy loam, 3 to 8 percent slopes

Setting

Landform: Terraces along the Brazos and Bosque Rivers
Distinctive landscape features: Terrace scarps
Landscape position: Hillsides of terrace scarps
Slope: Gently sloping or moderately sloping
Shape of areas: Elongated along landscape breaks
Size of areas: 20 to 300 acres

Typical Profile

Surface layer:
0 to 8 inches—brown fine sandy loam

Subsoil:
8 to 20 inches—reddish brown sandy clay loam
20 to 48 inches—yellowish red sandy clay loam
48 to 72 inches—yellowish red fine sandy loam

Underlying material:
72 to 80 inches—reddish yellow loamy fine sand

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None

Runoff: Rapid
Permeability: Moderate
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Medium
Soil reaction: Slightly acid or neutral in the surface layer and moderately acid to slightly alkaline in the subsoil
Shrink-swell potential: Low
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate

Composition

Gholson soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The well drained Bastsil soils along flats
- The well drained, sandy Dutek soils along the slightly higher hillsides
- The well drained, calcareous Weswood soils along the slightly lower flood plains
- The well drained, slowly permeable Minwells soils along the slightly higher ridges and slopes
- The moderately well drained, very slowly permeable Mabank soils in depressions

Land Uses

Major land use: Pasture
Other land uses: Cropland, recreation, wildlife habitat

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- Construction of farm ponds is not recommended because of excessive seepage.
- The moderate available water capacity may limit production in some years.

Cropland

Major limitations:
- The content of organic matter is low in this soil.
- Because of the hazards of water erosion and wind erosion, crop residue should be left on the surface to prevent excessive soil loss and increase the content of organic matter.

Minor limitations:
- None

Rangeland

Major limitations:
- None

Minor limitations:
- Construction of farm ponds for livestock water is not recommended because of excessive seepage.

Urban development

Major limitations:
- None

Minor limitations:
- Seepage of effluent into ground water is possible in areas used for septic tank absorption fields.
- Many areas are underlain by beds of sand and gravel.

Interpretive Groups

Land capability classification: IVe
Range site: Sandy Loam

Go—Gowen clay loam, frequently flooded

Setting

Landform: Holocene-age flood plains along local streams
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated and narrow
Size of areas: 20 to 300 acres

Typical Profile

Surface layer:
0 to 12 inches—dark brown clay loam

Subsurface layer:
12 to 42 inches—brown clay loam and sandy clay loam

Underlying material:
42 to 55 inches—grayish brown sandy clay loam
55 to 80 inches—very pale brown sandy clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: Frequent, of very brief duration
Runoff: Slow
Permeability: Moderate
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Neutral to moderately alkaline
Shrink-swell potential: Moderate

Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Gowen soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained, clayey Frio soils on flood plains
• The moderately well drained, clayey Tinn soils in slight depressions on flood plains

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, recreation

Management Concerns

Pasture

Major limitations:
• The soil is flooded about once every 1 to 2 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.
Minor limitations:
• Construction of farm ponds is not recommended because of seepage.

Cropland

Major limitations:
• Crop losses can occur because of flooding. Some areas are used for small grain, forage sorghum, or other crops.
Minor limitations:
• The available water capacity is high, but crop stress can occur on this well drained soil during dry periods.

Rangeland

Major limitations:
• None
Minor limitations:
• Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
Minor limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.

Interpretive Groups

Land capability classification: Vw
Range site: Loamy Bottomland

HeB—Heiden clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping, slightly concave
Shape of areas: Irregular or rounded
Size of areas: 10 to 400 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown clay

Subsurface layer:
6 to 14 inches—dark grayish brown clay

Subsoil:
14 to 55 inches—dark grayish brown, grayish brown, and light brownish gray clay

Underlying material:
55 to 80 inches—yellow shale with clay texture

Soil Properties

Depth: Deep to shale
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: High
Root zone: Deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Heiden soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained Lott and McLennan soils on hillsides
• The moderately deep Austin soils on foot slopes and ridges

• The well drained, deep Ferris soils on hillsides
• The moderately well drained Houston Black soils on the lower foot slopes

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness during wet periods.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
• Because of the moderate hazard of water erosion, management of crop residue, terraces, or grassed waterways may be needed to prevent excessive soil loss.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, sidewalks, roads, and streets to crack or buckle.
• The very slow permeability may cause septic systems to work improperly.
• Establishing and maintaining lawns and landscape plants can be difficult on this clayey soil.
• Shallow excavations sometimes cave in.
Minor limitations:
• The very slow permeability can cause water to accumulate for short periods in some areas.

Interpretive Groups

Land capability classification: IIe
Range site: Blackland

HeC—Heiden clay, 3 to 5 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Shaly hillsides
Landscape position: Hillsides
Slope: Gently sloping
Shape of areas: Elongated or irregular
Size of areas: 30 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—grayish brown clay

Subsurface layer:
6 to 22 inches—dark grayish brown clay

Subsoil:
22 to 52 inches—light brownish gray clay

Underlying material:
52 to 80 inches—olive gray and yellow shale with clay texture

Soil Properties

Depth: Deep to shale
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: High
Root zone: Deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Heiden soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Crockett soils on ridgetops and foot slopes
• The loamy McLennan soils along hillsides
• The very deep Ferris soils along hillsides

• A few gullies and areas of eroded Heiden soils

Land Uses

Major land use: Cropland
Other land uses: Rangeland, pasture, recreation

Management Concerns

Pasture

Major limitations:
• Establishment of pasture species is difficult on this clayey, erodible soil.
Minor limitations:
• The very slow permeability and rapid runoff make it difficult for water to infiltrate the soil.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
• Because of the severe hazard of water erosion, cropping systems that produce large amounts of crop residue are needed to maintain soil tilth, increase the rate of water infiltration, and prevent excessive soil loss. Terraces and grassed waterways also help to control erosion.
Minor limitations:
• The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
• The very slow permeability can cause septic systems to work improperly.
Minor limitations:
• Establishment and maintenance of lawns and landscape plants can be difficult on this clayey, gently sloping soil.

Interpretive Groups

Land capability classification: IIIe
Range site: Blackland

HeD—Heiden clay, 5 to 8 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Shaly hillsides
Landscape position: Hillsides
Slope: Moderately sloping
Shape of areas: Elongated or irregular
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown clay

Subsurface layer:
6 to 14 inches—grayish brown clay

Subsoil:
14 to 50 inches—light brownish gray clay

Underlying material:
50 to 80 inches—yellow shale with clay texture

Soil Properties

Depth: Deep to shale
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: High
Root zone: Deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Heiden soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Houston Black soils along foot slopes
• The loamy McLennan and Lamar soils and clayey Lott soils along hillsides
• The light colored Ellis and Ferris soils along hillsides

• A few uncrossable gullies and areas where the topsoil has been removed by erosion

Land Uses

Major land use: Rangeland
Other land uses: Cropland, pasture, recreation

Management Concerns

Pasture

Major limitations:
• Establishment of pasture species is difficult on this clayey, highly erodible soil.
Minor limitations:
• The very slow permeability and rapid runoff make it difficult for water to infiltrate the soil.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
• Because of the severe hazard of water erosion and the slope, cropping systems that produce large amounts of crop residue are needed to maintain soil tilth, increase the rate of water infiltration, and prevent excessive soil loss. Terraces and grassed waterways also help to control erosion.
Minor limitations:
• The rapid runoff and very slow permeability may limit the amount of water that can enter the soil.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• The rapid runoff and very slow permeability make it difficult for water to infiltrate the soil.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
• The very slow permeability and the slope can cause septic systems to work improperly.
Minor limitations:
• Establishment and maintenance of lawns and landscape plants can be difficult on this clayey, moderately sloping soil.

Interpretive Groups

Land capability classification: IVe
Range site: Blackland

HgB—Heiden gravelly clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Lower hillsides and foot slopes
Slope: Gently sloping
Shape of areas: Elongated or irregular
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown gravelly clay

Subsurface layer:
6 to 38 inches—dark brown clay

Subsoil:
38 to 55 inches—brown silty clay

Underlying material:
55 to 80 inches—reddish yellow shale with clay texture

Soil Properties

Depth: Deep to shale
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Very slow
Available water capacity: High
Root zone: Deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Heiden soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Crockett soils along foot slopes

- The lighter colored Lott and Lamar soils along the lower hillsides
- The loamy McLennan and Lamar soils along hillsides
- The light colored Ellis and Ferris soils along hillsides
- The moderately well drained Houston Black soils on foot slopes

Land Uses

Major land use: Rangeland
Other land uses: Cropland, pasture, recreation

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- The clayey texture limits the choice of suitable forage plants. Many areas support improved bermudagrass and kleingrass.
- Maintenance of fences is costly because of shrinking and swelling of the soil.
- The rapid runoff and very slow permeability make it difficult for water to infiltrate the soil.

Cropland

Major limitations:
- None

Minor limitations:
- The gravelly surface layer is difficult to cultivate under some moisture conditions.

Rangeland

Major limitations:
- None

Minor limitations:
- The rapid runoff and very slow permeability make it difficult for water to infiltrate the soil.
- Maintenance of fences is costly because of shrinking and swelling of the soil.

Urban development

Major limitations:
- Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
- The very slow permeability can cause septic systems to fail.

Minor limitations:
- Establishment and maintenance of lawns and landscape plants can be difficult on this clayey soil.

Interpretive Groups

Land capability classification: IIe
Range site: Blackland

HoB—Houston Black clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping
Shape of areas: Rounded or irregular
Size of areas: 10 to 2,000 acres

Typical Profile

Surface layer:
0 to 6 inches—very dark gray clay

Subsurface layer:
6 to 25 inches—very dark gray clay

Subsoil:
25 to 75 inches—dark gray, gray, and grayish brown clay

Underlying material:
75 to 80 inches—yellow shale with clay texture

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Houston Black soil and similar inclusions: 90 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

- The noncalcareous Burleson soils on broad flats
- The well drained Heiden and Ferris soils on the upper slopes and hillsides

• The well drained Krum and Lewisville soils in the slightly lower positions
• The moderately well drained Branyon soils on broad flats
• The moderately well drained Slidell soils in the slightly higher positions

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness during wet periods.
• Maintenance of fences is costly because of shrinking and swelling of the soil.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
• Because of the moderate hazard of water erosion, management of crop residue, terraces, or grassed waterways may be needed to prevent excessive soil loss.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.
• Shrinking and swelling of the soil can cause fences to sag.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
• The very slow permeability can cause septic systems to work improperly.
• Establishing lawns and landscape plants is difficult on this clayey soil.
• Shallow excavations sometimes cave in.
Minor limitations:
• The slow runoff and very slow permeability can cause water to accumulate for short periods.

Interpretive Groups

Land capability classification: IIe
Range site: Blackland

KrC—Krum silty clay, 2 to 5 percent slopes

Setting

Landform: Stream terraces and infilled valleys of Pleistocene age
Distinctive landscape features: None
Landscape position: Foot slopes and hillsides
Slope: Gently sloping
Shape of areas: Elongated
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown silty clay

Subsurface layer:
6 to 24 inches—dark brown silty clay

Subsoil:
24 to 42 inches—light brown silty clay
42 to 50 inches—reddish yellow silty clay
50 to 65 inches—reddish yellow gravelly silty clay loam

Underlying material:
65 to 80 inches—reddish yellow silty clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Krum soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Branyon soils on broad flats
• The noncalcareous Burleson soils on broad flats
• The well drained Sunev and Lewisville soils in positions similar to those of the Krum soil
• The Bosque and Frio soils along flood plains
• Many areas of steep banks and natural drainageways

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The soil cracks when dry. The cracking can cause fences to sag.

Cropland

Major limitations:
• None
Minor limitations:
• Because of the moderate hazard of water erosion, management of crop residue, terraces, or grassed waterways may be needed to prevent excessive soil loss.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil at a moderately slow rate.

Rangeland

Major limitations:
• None
Minor limitations:
• None

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
• The moderately slow permeability can sometimes cause septic systems to fails.
Minor limitations:
• The slope and erosion can make establishment and maintenance of lawns difficult.

Interpretive Groups

Land capability classification: IIIe
Range site: Clay Loam

LaD—Lamar clay loam, 3 to 8 percent slopes

Setting

Landform: Stream terraces of Pleistocene age
Distinctive landscape features: None
Landscape position: Hillsides on terrace breaks
Slope: Gently sloping or moderately sloping
Shape of areas: Elongated
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—brown clay loam

Subsurface layer:
6 to 17 inches—brown clay loam

Subsoil:
17 to 44 inches—brownish yellow loam

Underlying material:
44 to 52 inches—brownish yellow loam
52 to 80 inches—yellow loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderate
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Medium
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Lamar soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The moderately well drained Crockett soils along foot slopes and ridges
- The darker Krum and Lewisville soils along the less sloping tops of terraces
- The moderately well drained Branyon and Burleson soils along broad flats
- The clayey Heiden, Ferris, and Houston Black soils along foot slopes and ridgetops

Land Uses

Major land use: Pasture
Other land uses: Rangeland, cropland

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- The moderate available water capacity limits production. Many areas support drought-tolerant species, such as improved bermudagrass.
- Construction of farm ponds is not recommended because of seepage.

Cropland

Major limitations:
- Because of the severe hazard of water erosion, cropping systems that leave large amounts of crop residue on the surface are needed to maintain the content of organic matter and prevent excessive soil loss.

Minor limitations:
- The moderate available water capacity may limit yields.

Rangeland

Major limitations:
- None

Minor limitations:
- The moderate available water capacity may limit production.
- Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
- Because of the severe hazard of water erosion, establishing lawns and landscape plants is expensive.

Minor limitations:
- Because of the moderate available water capacity, maintaining lawns is expensive.
- Shrinking and swelling of soil can cause houses, roads, and streets to crack or buckle.

Interpretive Groups

Land capability classification: IVe
Range site: Clay Loam

LeB—Lewisville silty clay, 1 to 3 percent slopes

Setting

Landform: Stream terraces of Pleistocene age
Distinctive landscape features: None
Landscape position: Foot slopes and terrace flats
Slope: Gently sloping
Shape of areas: Rounded or elongated
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 12 inches—brown silty clay

Subsurface layer:
12 to 20 inches—brown silty clay

Subsoil:
20 to 52 inches—brown silty clay
52 to 70 inches—pink gravelly silty clay loam

Underlying material:
70 to 80 inches—reddish yellow silty clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderate
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Lewisville soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The moderately well drained Branyon soils on broad flats

Figure 10.—Cattle grazing forage sorghum on Lewisville silty clay, 1 to 3 percent slopes. Forage sorghum is commonly grown for hay or grazing on this soil.

- Bosque and Frio soils along narrow flood plains
- The well drained Krum and Sunev soils on flats, breaks, and alluvial flood plains
- Small areas of the well drained Lamar soils near landscape breaks

Land Uses

Major land use: Cropland (fig. 10)
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- Construction of farm ponds is not recommended because of possible seepage in the gravelly subsoil layers.

Cropland

Major limitations:
- None

Minor limitations:
- Because of the moderate hazard of water erosion, cropping systems that leave large amounts of crop residue on the surface are needed to prevent excessive soil loss and maintain the content of organic matter.

• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• None

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
Minor limitations:
• Establishing lawns and landscape plants is difficult on this clayey soil.
• Shallow excavations sometimes cave in.

Interpretive Groups

Land capability classification: IIe
Range site: Clay Loam

LoB—Lott silty clay, 1 to 5 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Convex hillsides
Slope: Gently sloping
Shape of areas: Elongated or irregular
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 5 inches—dark brown silty clay

Subsurface layer:
5 to 12 inches—brown silty clay

Subsoil:
12 to 36 inches—brown silty clay
36 to 52 inches—reddish yellow silty clay and silty clay loam

Underlying material:
52 to 80 inches—reddish yellow silty clay loam and clayey marl

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderately slow
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Medium
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Lott soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The very deep Ellis, Ferris, and Lamar soils along hillsides
• The loamy McLennan soils along hillsides
• The deep Heiden and very deep Houston Black soils along foot slopes
• A few uncrossable gullies and areas where the topsoil has been removed by erosion

Land Uses

Major land use: Cropland
Other land uses: Rangeland, pasture, recreation

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production.

Cropland

Major limitations:
• Because of the severe hazard of water erosion, cropping systems that produce large amounts of crop residue are needed to prevent excessive soil loss and maintain the content of organic matter.
Minor limitations:
• None

Rangeland

Major limitations:
• None
Minor limitations:
• Production may be low during dry periods because of the moderate available water capacity.

Urban development

Major limitations:
• The moderately slow permeability may cause septic systems to fail.
Minor limitations:
• Maintenance of lawns and grasses is difficult on this clayey, gently sloping soil.
• Shrinking and swelling of the soil can cause houses, roads, and streets to crack or buckle.

Interpretive Groups

Land capability classification: IIIe
Range site: Clay Loam

LoD—Lott silty clay, 5 to 8 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Convex hillsides
Slope: Moderately sloping
Shape of areas: Elongated or irregular
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—dark gray silty clay

Subsurface layer:
4 to 16 inches—dark grayish brown silty clay

Subsoil:
16 to 44 inches—light yellowish brown silty clay

Underlying material:
44 to 60 inches—pale yellow shale with clay texture and clayey marl.

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Medium
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Lott soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The clayey Ferris soils along hillsides
• The very deep Lamar soils along the lower hillsides
• The loamy McLennan soils along hillsides
• The deep Heiden and very deep Houston Black soils along foot slopes
• Many uncrossable gullies and areas where the topsoil has been removed by erosion

Land Uses

Major land use: Rangeland
Other land uses: Pasture, recreation

Management Concerns

Pasture

Major limitations:
• Establishment of pasture species is difficult on this highly erodible soil.
Minor limitations:
• The moderate available water capacity limits production.
• The rapid runoff and moderately slow permeability make it difficult for water to infiltrate the soil.

Cropland

Major limitations:
• This soil is poorly suited to cropland because of the slope and the severe hazard of water erosion.
Minor limitations:
• None

Rangeland

Major limitations:
• None
Minor limitations:
• Production may be low during dry periods because of the moderate available water capacity.
• Weeds and brush are difficult to control on this moderately sloping soil.

Urban development

Major limitations:
• The moderately slow permeability and the slope can cause septic systems to fail.
Minor limitations:
• Maintenance of lawns and grasses is difficult on this clayey, moderately sloping soil.

• Shrinking and swelling of the soil can cause buildings, roads, and streets to crack or buckle.

Interpretive Groups

Land capability classification: IVe
Range site: Clay Loam

MaA—Mabank fine sandy loam, 0 to 1 percent slopes

Setting

Landform: Stream terraces of Pleistocene age
Distinctive landscape features: None
Landscape position: Broad flats
Slope: Nearly level, plane
Shape of areas: Rounded or irregular
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 7 inches—grayish brown fine sandy loam

Subsoil:
7 to 26 inches—very dark gray clay
26 to 36 inches—gray clay
36 to 80 inches—grayish brown and light brownish gray clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None; however, may be saturated above the subsoil for short periods after heavy rainfall
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: Moderate
Root zone: Very deep, but slowly penetrated by plant roots
Natural soil fertility: Low
Soil reaction: Slightly acid or neutral in the surface layer and moderately acid to moderately alkaline in the subsoil
Shrink-swell potential: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Mabank soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Axtell soils in the slightly higher positions
• The well drained Minwells soils on hillsides and ridges
• The moderately well drained Chazos soils on ridgetops
• The moderately well drained Crockett soils on hillsides
• The moderately well drained Bremond soils in the slightly higher positions
• The moderately well drained Wilson soils in the slightly lower positions

Land Uses

Major land use: Pasture
Other land uses: Rangeland, cropland, recreation, urban development

Management Concerns

Pasture

Major limitations:
• The very slow permeability limits the amount of moisture that can infiltrate the soil and be stored for plant use. Much of the annual rainfall is lost as runoff. Many areas support common bermudagrass and improved bermudagrass.
Minor limitations:
• The moderate available water capacity limits the production potential.

Cropland

Major limitations:
• The very slow permeability in the subsoil limits the amount of water infiltrating the soil. Most of the cropland is used for cool-season crops, such as small grain, or fast-growing, early maturing crops, such as forage sorghum.
Minor limitations:
• In wet seasons the very slow permeability can cause the surface to be saturated and delay planting.

Rangeland

Major limitations:
• The very slow permeability limits the amount of water infiltrating the soil, and production may be low in dry years.
Minor limitations:
• The moderate available water capacity limits production.

Urban development

Major limitations:
• The very slow permeability in the subsoil can cause septic systems to fail in wet periods.
• Shrinking and swelling of the soil can cause buildings and roads to crack.
Minor limitations:
• Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity.

Interpretive Groups

Land capability classification: IIIw
Range site: Claypan Prairie

MbA—Mabank-Bremond complex, 0 to 1 percent slopes

Setting

Landform: Stream terraces of Pleistocene age
Distinctive landscape features: Mabank soil—slight depressions; Bremond soil—slight mounds
Landscape position: Broad flats
Slope: Nearly level
Shape of areas: Rounded or irregular
Size of areas: 20 to 300 acres

Typical Profile

Mabank soil

Surface layer:
0 to 7 inches—grayish brown fine sandy loam

Subsoil:
7 to 60 inches—very dark gray clay
60 to 80 inches—light brownish gray clay

Bremond soil

Surface layer:
0 to 8 inches—light yellowish brown loam

Subsoil:
8 to 60 inches—brown and dark yellowish brown clay
60 to 80 inches—yellowish brown clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: Mabank—none; however, may be saturated above the subsoil for short periods after heavy rainfall; Bremond—none
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: Moderate
Root zone: Very deep, but slowly penetrated by plant roots
Natural soil fertility: Medium
Soil reaction: Slightly acid
Shrink-swell potential: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Mabank soil and similar inclusions: 60 percent
Bremond soil and similar inclusions: 25 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Wilson soils on broad flats
• The moderately well drained Axtell soils on the slightly higher ridges
• The moderately well drained Crockett and well drained Lamar soils along hillsides

Land Uses

Major land use: Pasture
Other land uses: Rangeland, cropland, urban development

Management Concerns

Pasture

Major limitations:
• The very slow permeability limits the amount of moisture that can infiltrate the soils and be stored for plant use.
Minor limitations:
• The moderate available water capacity limits the production of forage.

Cropland

Major limitations:
• In wet seasons the very slow permeability and slow runoff can delay planting and slow crop growth.
Minor limitations:
• The moderate available water capacity limits the production of crops.

Rangeland

Major limitations:
• The very slow permeability limits the amount of water that can infiltrate the soils.
Minor limitations:
• The moderate available water capacity may limit yields in some years.

Urban development

Major limitations:
• The very slow permeability can cause septic systems to fail in wet seasons.
• Shrinking and swelling of the soils can cause buildings, roads, and streets to crack or buckle.
Minor limitations:
• Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity.

Interpretive Groups

Land capability classification: Mabank soil—IIIw; Bremond soil—IIw
Range site: Mabank and Bremond soils—Claypan Prairie

McE—McLennan clay loam, 8 to 15 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Shaly hills
Landscape position: Hillsides
Slope: Strongly sloping or moderately steep, convex
Shape of areas: Elongated or irregular
Size of areas: 30 to 300 acres

Typical Profile

Surface layer:
0 to 7 inches—grayish brown clay loam

Subsoil:
7 to 14 inches—light olive brown clay loam
14 to 32 inches—light yellowish brown clay loam

Underlying material:
32 to 80 inches—olive yellow silty clay loam interbedded with limestone and weathered shale

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: Low
Root zone: Moderately deep
Natural soil fertility: Medium
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

McLennan soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The clayey Ellis and Ferris soils along hillsides
• The very deep Lott and Lamar soils along the lower hillsides
• The deep, clayey Heiden and very deep, clayey Houston Black soils along foot slopes
• Many uncrossable gullies and areas where the topsoil has been removed by erosion

Land Uses

Major land use: Rangeland
Other land uses: Pasture, recreation

Management Concerns

Pasture

Major limitations:
• Establishment of pasture species is difficult on this highly erodible soil.
Minor limitations:
• The low available water capacity limits production.
• The rapid runoff and moderately slow permeability make it difficult for water to infiltrate the soil.

Cropland

Major limitations:
• This soil is poorly suited to cropland because of the slope and the severe hazard of water erosion.
Minor limitations:
• The low available water capacity limits yields.

Rangeland

Major limitations:
• Production may be low during dry periods because of the low available water capacity.
Minor limitations:
• Weeds and brush are difficult to control on the moderately steep slopes.

Urban development

Major limitations:
• The moderately slow permeability and the slope can cause septic systems to fail.
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.
Minor limitations:
• Maintenance of lawns and grasses is difficult on

this clayey, strongly sloping or moderately steep soil because of the low available water capacity.

Interpretive Groups

Land capability classification: VIe
Range site: Eroded Blackland

MnB—Minwells fine sandy loam, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: None
Landscape position: Side slopes and ridges above drainageways
Slope: Gently sloping, convex
Shape of areas: Elongated or rounded
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 8 inches—brown fine sandy loam

Subsoil:
8 to 25 inches—reddish brown clay
25 to 38 inches—red clay
38 to 55 inches—red sandy clay
55 to 60 inches—light red sandy clay

Underlying material:
60 to 65 inches—reddish yellow gravelly sandy clay loam
65 to 80 inches—reddish yellow very gravelly sandy clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Slow
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Slightly acid to slightly alkaline in the surface layer and slightly acid to moderately alkaline in the subsoil
Shrink-swell potential: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Minwells soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Mabank soils in depressions
• The moderately well drained Chazos soils on foot slopes
• The moderately well drained Axtell and Crockett soils on hillsides

Land Uses

Major land use: Pasture
Other land uses: Rangeland, cropland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The slow permeability limits the amount of moisture that can infiltrate the soil and be stored for plant use. Much of the annual rainfall is lost as runoff. Many areas support common bermudagrass and improved bermudagrass.
• The moderate available water capacity limits the production potential.

Cropland

Major limitations:
• None
Minor limitations:
• The slow permeability in the subsoil limits the amount of water infiltrating the soil. Most of the cropland is used for cool-season crops, such as small grain, or fast-growing, early maturing crops, such as forage sorghum.
• The moderate hazard of water erosion limits the kinds of crops that can be grown. Crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.
• The moderate available water capacity may limit yields.

Rangeland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production.

• The slow permeability limits the amount of water infiltrating the soil, and production may be low in dry years. The climax vegetation was post oak savannah.

Urban development

Major limitations:
• None
Minor limitations:
• Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity.
• The slow permeability in the subsoil can cause septic systems to fail in wet years.
• Shrinking and swelling of the soil can cause buildings and roads to crack.

Interpretive Groups

Land capability classification: IIe
Range site: Sandy Loam

MnC2—Minwells fine sandy loam, 3 to 5 percent slopes, eroded

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: Areas where the topsoil has eroded and shallow gullies are common
Landscape position: Side slopes and breaks above drainageways
Slope: Gently sloping, convex
Shape of areas: Elongated or rounded
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—brown fine sandy loam

Subsoil:
4 to 28 inches—reddish brown clay
28 to 45 inches—red clay
45 to 60 inches—light red sandy clay

Underlying material:
60 to 80 inches—reddish yellow gravelly sandy clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Slow
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Slightly acid to slightly alkaline in the surface layer and slightly acid to moderately alkaline in the subsoil
Shrink-swell potential: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Moderate

Composition

Minwells soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Mabank soils in depressions
• The moderately well drained Chazos soils on foot slopes and ridges
• The moderately well drained Axtell soils on hillsides and ridges
• The moderately well drained Crockett soils on hillsides

Land Uses

Major land use: Pasture
Other land uses: Rangeland, wildlife habitat, recreation

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The slow permeability limits the amount of moisture that can infiltrate the soil and be stored for plant use. Much of the annual rainfall is lost as runoff. Many areas support common bermudagrass and improved bermudagrass.
• The moderate available water capacity limits the production potential.

Cropland

Major limitations:
• Because of the severe hazard of water erosion, cropping systems that leave large amounts of crop residue on the surface are needed to maintain the content of organic matter and prevent excessive soil loss.
Minor limitations:
• The slow permeability in the subsoil limits the amount of water infiltrating the soil.

Rangeland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production.
• The slow permeability limits the amount of water infiltrating the soil, and production may be low in dry years. The climax vegetation was post oak savannah.

Urban development

Major limitations:
• The slope and the erosion hazard may make establishment of lawns difficult and expensive.
Minor limitations:
• Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity.
• The slow permeability in the subsoil can cause septic systems to fail in wet years.
• Shrinking and swelling of the soil can cause buildings and roads to crack.
• Proper design and installation can overcome these limitations.

Interpretive Groups

Land capability classification: IIIe
Range site: Sandy Loam

OgB—Oglesby silty clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Ridgetops
Slope: Gently sloping, convex
Shape of areas: Irregular or rounded
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown silty clay

Subsurface layer:
6 to 18 inches—dark brown silty clay

Underlying material:
18 to 35 inches—fractured, indurated limestone bedrock; the fractures filled with silty clay

Soil Properties

Depth: Shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Slow
Available water capacity: Very low
Root zone: Shallow
Natural soil fertility: High
Soil reaction: Neutral to moderately alkaline and noncalcareous
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Oglesby soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately deep Bolar and Denton soils on foot slopes
• The light colored Brackett soils on hillsides
• The moderately deep, clayey Crawford soils on hillsides
• The very deep Sunev soils on foot slopes
• Limestone rock outcrops along hillsides

Land Uses

Major land use: Cropland
Other land uses: Rangeland, pasture

Management Concerns

Pasture

Major limitations:
• The very low available water capacity limits the choice of forage plants to those that are drought tolerant, such as kleingrass and improved bermudagrass.
• The very low available water capacity limits the yield capacity.
Minor limitations:
• Fence construction is difficult and costly because of the limited depth to bedrock.
• Construction of farm ponds for livestock water is not recommended because of excessive seepage and the depth to bedrock.

Cropland

Major limitations:
• This soil is poorly suited to crops because of the

very low available water capacity and the limited depth to bedrock.

Minor limitations:

• Because of the moderate hazard of water erosion, cropping systems that leave large amounts of crop residue on the surface are needed to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:

• Production may be low during dry periods because of the very low available water capacity and the limited root zone.

Minor limitations:

• Construction of fences is costly because digging in the limestone bedrock is difficult.

• Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:

• Excavation of the limestone bedrock is difficult.

• Maintenance of lawn grasses and landscape plants is expensive because of the very low available water capacity and the limited depth to bedrock.

Minor limitations:

• Road excavations are difficult because of the limestone bedrock.

Interpretive Groups

Land capability classification: IVs
Range site: Shallow Clay

Ov—Ovan silty clay, frequently flooded

Setting

Landform: Holocene-age flood plains along local streams
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated and narrow
Size of areas: 20 to 300 acres

Typical Profile

Surface layer:
0 to 20 inches—dark grayish brown silty clay

Subsurface layer:
20 to 35 inches—grayish brown silty clay

Subsoil:
35 to 80 inches—pale brown silty clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: Frequent, of very brief duration
Runoff: Slow
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Ovan soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained, clayey Frio soils on flood plains

• The moderately well drained, clayey Tinn soils on hillsides bordering flood plains

• The well drained Sunev and Lewisville soils on hillsides bordering flood plains

• The well drained Heiden and moderately well drained Houston Black soils along foot slopes bordering flood plains

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, recreation

Management Concerns

Pasture

Major limitations:

• The soil is flooded about once every 1 to 2 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.

Minor limitations:

• None

Cropland

Major limitations:

• Crop losses can occur because of flooding. Some areas are used for small grain, forage sorghum, or other crops.

Minor limitations:

• This slowly permeable, clayey soil can be wet for

short periods. The wetness may delay planting in some years.

Rangeland

Major limitations:
• This soil is well suited to rangeland, but flooding may be a problem in some years.
Minor limitations:
• None

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
• The very slow permeability can cause septic systems to fail.
Minor limitations:
• Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.

Interpretive Groups

Land capability classification: Vw
Range site: Clayey Bottomland

PcB—Payne clay loam, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age stream terraces
Distinctive landscape features: None
Landscape position: Broad flats and side slopes
Slope: Gently sloping, slightly convex
Shape of areas: Rounded or irregular
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 8 inches—dark grayish brown clay loam

Subsoil:
8 to 45 inches—brown clay
45 to 72 inches—yellowish red clay

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: High
Root zone: Deep
Natural soil fertility: Medium
Soil reaction: Slightly acid or neutral in the surface layer, neutral in the upper part of the subsoil, grading to moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Payne soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Wilson soils on broad flats
• The well drained, calcareous Lewisville and Lamar soils near terrace breaks
• The very shallow Queeny soils near breaks

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, urban development

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness and limit the amount of moisture infiltrating the soil.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which may delay farming operations.
• Because of the moderate hazard of water erosion, cropping systems that leave crop residue on the surface are needed to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability may limit the amount of moisture infiltrating the soil.

Urban development

Major limitations:
• None

Minor limitations:
- The very slow permeability and slow runoff may cause temporary wetness.
- Shrinking and swelling of the soil can cause roads and buildings to crack or buckle.
- The very slow permeability can cause septic systems to fail in wet seasons.

Interpretive Groups

Land capability classification: IIIe
Range site: Claypan Prairie

Pg—Pits, gravel

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: Man-made borrow pits
Landscape position: Pits
Slope: Nearly level to strongly sloping
Shape of areas: Irregular or rectangular
Size of areas: 5 to 200 acres

Characteristics of the Pits

This map unit consists of areas from which soil and the underlying gravel or sand have been mined for topsoil or for sand and gravel. The walls of the pits are mostly vertical. The depth of the pits ranges from about 10 to 75 feet. In most areas water stands on part of the pit most of the year. In many areas the original loamy and clayey soil was mixed during excavation of sand and gravel and was left in piles in the pits. Most of the pits are in areas of gravelly sediments near the Brazos and Bosque Rivers or in areas of ancient high terrace deposits associated with these streams.

Soil Properties

Depth: Very deep
Drainage class: Poorly drained
Water table: Standing water on the bottom of the pits
Flooding: Common
Runoff: Slow
Permeability: Variable
Available water capacity: High
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Pits and similar inclusions: 90 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

- The well drained Weswood soils on flood plains
- The moderately well drained Burleson and Wilson soils on flats
- The well drained Bastsil soils on low hills

Land Uses

Major land use: Recreation
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
- Reclaiming these areas is very costly. The gravel layer at the bottom of the pits is often saturated with water. There is insufficient soil material to reshape and revegetate the areas.

Minor limitations:
- Much of the fertile topsoil has been hauled away or covered with other material.
- Control of woody vegetation is difficult. Willows and cottonwood trees dominate many areas.

Cropland

Major limitations:
- These areas are poorly suited to cropland because of location and erosion.

Minor limitations:
- None

Rangeland

Major limitations:
- Reclaimed areas can be used as rangeland. Control of woody vegetation is difficult in most areas that have not been reclaimed. Willows and cottonwood trees dominate the areas that have mounds of soil.

Minor limitations:
- None

Urban development

Major limitations:
- These areas are poorly suited to urban development because of flooding, depth, and insufficient soil material to reclaim for urban uses.

Minor limitations:
- None

Interpretive Groups

Land capability classification: VIIIs

Range site: Not assigned

Pr—Pits, quarry

Setting

*Landform:*Uplands of Lower Cretaceous age
Distinctive landscape features: Man-made rock pits
Landscape position: Pits
Slope: Nearly level or gently sloping
Shape of areas: Irregular or rectangular
Size of areas: 5 to 100 acres

Characteristics of the Pits

This map unit consists of areas from which soil and the underlying limestone have been removed for use as road base, cement, commercial lime, agricultural lime, and other purposes. The walls of the pits generally are vertical. The depth of the pits ranges from about 10 to 50 feet. The bottom of the pits generally is bare limestone bedrock. Some of the pits are partially covered with water for short periods. Most of the pits are in areas of the Austin Chalk geological formation or in areas of the hard limestone of the Lower Cretaceous formations in the western part of the county.

Soil Properties

Depth: Very shallow
Drainage class: Well drained
Water table: Variable
Flooding: None or common
Runoff: Slow
Permeability: Moderate
Available water capacity: Very low
Root zone: Very shallow
Natural soil fertility: Low
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Pits and similar inclusions: 90 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• A few remnants of the well drained Eckrant, Purves, Denton, Eddy, and other shallow soils that formed in material weathered from limestone.

Land Uses

Major land use: Rangeland
Other land use: Recreation

Management Concerns

Pasture

Major limitations:
• These areas are poorly suited to pasture because of the depth to bedrock.
Minor limitations:
• None

Cropland

Major limitations:
• These areas are poorly suited to cropland because of the depth to bedrock.
Minor limitations:
• None

Rangeland

Major limitations:
• These areas are poorly suited to rangeland, but sparse vegetation that can be grazed by livestock grows in some areas.
Minor limitations:
• None

Urban development

Major limitations:
• These areas are poorly suited to urban development because of the depth to bedrock.
Minor limitations:
• None

Interpretive Groups

Land capability classification: VIIIs
Range site: Not assigned

PvB—Purves clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Hillsides and foot slopes
Slope: Gently sloping, convex
Shape of areas: Irregular or rounded
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 4 inches—brown clay

Subsurface layer:
4 to 9 inches—brown gravelly clay

Subsoil:
9 to 15 inches—brown very gravelly clay

Underlying material:
15 to 25 inches—fractured, indurated limestone bedrock interbedded with chalk, marl, and clay

Soil Properties

Depth: Shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Moderately slow
Available water capacity: Very low
Root zone: Shallow
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Purves soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The shallow or very shallow, loamy Aledo soils along ridges
- The moderately deep Bolar and Denton soils on foot slopes
- The light colored Brackett soils on hillsides
- The moderately deep, clayey Crawford soils on hilltops
- The very deep Sunev soils on foot slopes
- Limestone rock outcrops along hillsides

Land Uses

Major land use: Rangeland
Other land uses: Pasture, cropland, recreation

Management Concerns

Pasture

Major limitations:
- The very low available water capacity limits the choice of forage plants to those that are drought tolerant, such as kleingrass and improved bermudagrass.
- The very low available water capacity limits the yield capacity.

Minor limitations:
- Fence construction is difficult and costly because of the limited depth to bedrock.
- Construction of farm ponds for livestock water is not recommended because of excessive seepage.

Cropland

Major limitations:
- This soil is poorly suited to crops because of the very low available water capacity and the limited depth to bedrock.

Minor limitations:
- None

Rangeland

Major limitations:
- Production may be low during dry periods because of the very low available water capacity and the limited root zone.

Minor limitations:
- Construction of fences is costly because digging in the limestone bedrock is difficult.
- Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
- Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
- Excavation of the limestone bedrock is difficult.
- Maintenance of lawn grasses and landscape plants is expensive because of the very low available water capacity and the limited depth to bedrock.

Minor limitations:
- Road excavations are difficult because of the limestone bedrock.
- Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.

Interpretive Groups

Land capability classification: IVs
Range site: Shallow

QuC—Queeny clay loam, 1 to 5 percent slopes

Setting

Landform: Uplands on high terraces of Pleistocene age
Distinctive landscape features: Gravelly hills
Landscape position: Hilltops and hillslopes
Slope: Gently sloping

Shape of areas: Rounded or irregular
Size of areas: 5 to 30 acres

Typical Profile

Surface layer:
0 to 12 inches—brown clay loam

Subsoil:
12 to 20 inches—white, strongly cemented caliche embedded with siliceous and limestone fragments

Underlying material:
20 to 60 inches—white, weakly cemented caliche embedded with siliceous and limestone fragments, stratified with brownish yellow very gravelly sand containing about 60 percent limestone and siliceous fragments

Soil Properties

Depth: Shallow or very shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Slow
Available water capacity: Very low
Root zone: Shallow or very shallow
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Queeny soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The very deep Lott, Sanger, and Slidell soils on hillsides and foot slopes
• The very deep Payne and Wilson soils on broad flats
• The very deep Lewisville and Krum soils on breaks and hillsides

Land Uses

Major land use: Rangeland
Other land uses: Pasture, cropland

Management Concerns

Pasture

Major limitations:
• The very low available water capacity limits the choice of forage plants.
• Because of the limited depth to a cemented layer, establishing pasture species is difficult.
Minor limitations:
• Construction of fences is expensive because digging in the gravelly cemented subsoil is difficult.
• Construction of farm ponds is not recommended because of excessive seepage.

Cropland

Major limitations:
• This soil is poorly suited to cropland because of the limited depth to the gravelly cemented layer.
• Because of the severe hazard of water erosion, crop residue should be left on the surface to prevent excessive soil loss.
Minor limitations:
• None

Rangeland

Major limitations:
• The very low available water capacity limits production.
Minor limitations:
• Construction of fences is costly because digging in the gravelly cemented subsoil is difficult.
• Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
• Excavation is difficult because of the gravelly cemented layer.
Minor limitations:
• Shrinking and swelling in the surface layer can cause houses and streets to crack or buckle.

Interpretive Groups

Land capability classification: IVs
Range site: Chalky Ridge

ReF—Real-Rock outcrop complex, 10 to 30 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: Limestone hillsides
Landscape position: Convex hillsides
Slope: Strongly sloping to steep
Shape of areas: Elongated
Size of areas: 10 to 400 acres

Typical Profile

Real soil

Surface layer:
0 to 6 inches—dark brown gravelly clay loam

Subsurface layer:
6 to 14 inches—dark brown very gravelly clay loam

Underlying material:
14 to 40 inches—weakly and strongly cemented limestone interbedded with calcareous clay loam

Soil Properties

Real soil

Depth: Very shallow or shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderate
Available water capacity: Very low
Root zone: Very shallow or shallow
Natural soil fertility: Low
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Characteristics of the Rock Outcrop

The Rock outcrop consists of layers of strongly cemented limestone, generally in long and narrow horizontal bands that are 3 to 12 inches thick in most areas but are as much as 30 feet thick in some areas. The outcrops are mainly along the edges of escarpments and abrupt slope breaks. Some areas include large boulders that have broken away and fallen down the slopes. In some areas a layer of soil less than 4 inches thick overlies the rock outcrops.

Composition

Real soil and similar inclusions: 50 percent
Rock outcrop and similar inclusions: 35 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The light colored Brackett soils along hillsides
- The shallow Aledo soils along ridgetops
- The clayey Purves and Bolar soils along ridgetops
- The deep Bosque, Frio, and Lewisville soils along foot slopes

Land Uses

Major land use: Rangeland
Other land uses: Wildlife habitat, recreation

Management Concerns

Pasture

Major limitations:
- The Real soil is poorly suited to pasture because of the limited root zone, the very low available water capacity, and the slope.

Minor limitations:
- Construction of fences is very difficult and expensive.
- Construction of farm ponds is not recommended because of seepage, the slope, and the depth to bedrock.

Cropland

Major limitations:
- This unit is poorly suited to cropland because of the limited root zone, the Rock outcrop, and the slope.

Minor limitations:
- None

Rangeland

Major limitations:
- The low available water capacity and the limited root zone restrict production.

Minor limitations:
- Fences are difficult to construct because of the limestone bedrock and the slope.
- Construction of farm ponds is not recommended because of the slope, the hazard of water erosion, and the depth to bedrock.

Urban development

Major limitations:
- Construction is difficult because of the slope and the depth to limestone bedrock.
- Septic systems are difficult to establish and maintain because of the depth to bedrock.

Minor limitations:
- Lawns are difficult to establish and maintain because of the depth to bedrock.

Interpretive Groups

Land capability classification: Real soil—VIIs; Rock outcrop—VIIIs
Range site: Real soil—Steep Adobe

RgB—Riesel gravelly fine sandy loam, 1 to 3 percent slopes

Setting

Landform: Ancient terraces along the Brazos River
Distinctive landscape features: None

Landscape position: Side slopes and ridges above drainageways
Slope: Gently sloping, convex
Shape of areas: Elongated or rounded
Size of areas: 10 to 200 acres

Typical Profile

Surface layer:
0 to 6 inches—dark brown gravelly fine sandy loam

Subsurface layer:
4 to 16 inches—brown very gravelly fine sandy loam

Subsoil:
16 to 26 inches—red very gravelly clay
26 to 48 inches—light yellowish brown very gravelly clay
48 to 55 inches—pale yellow very gravelly clay

Underlying material:
55 to 80 inches—pale yellow very gravelly fine sand

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Slow
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Slightly acid or neutral in the surface layer and subsurface layer, moderately acid to slightly alkaline in the subsoil, and neutral to moderately alkaline in the underlying material
Shrink-swell potential: Moderate
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Riesel soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The moderately well drained Mabank soils in depressions
- The well drained Minwells soils on hillsides and ridges
- The moderately well drained Chazos soils on ridgetops
- The moderately well drained Axtell and Crockett soils on hillsides

Land Uses

Major land use: Pasture
Other land uses: Rangeland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
- The slow permeability limits the amount of moisture that can infiltrate the soil.
- The gravelly surface layer limits the amount of water stored for plant use. Much of the annual rainfall is lost as runoff. Many areas support common bermudagrass and improved bermudagrass.

Minor limitations:
- The moderate available water capacity limits the production potential.
- Because of the gravelly surface layer, establishing pasture species is difficult.

Cropland

Major limitations:
- This soil is poorly suited to cropland because cultivating the gravelly surface layer is difficult.

Minor limitations:
- The moderate available water capacity and the content of gravel limit yields.

Rangeland

Major limitations:
- The slow permeability limits the amount of water infiltrating the soil, and production may be low in dry years.

Minor limitations:
- The moderate available water capacity limits production.

Urban development

Major limitations:
- The slow permeability in the subsoil is a severe limitation when a septic system is installed.

Minor limitations:
- Maintenance of lawns and landscape plants can be expensive because of the moderate available water capacity, and lawns are difficult to establish because of the gravelly surface layer.
- Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.

Interpretive Groups

Land capability classification: VIs
Range site: Gravelly

SaB—San Saba clay, 0 to 2 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping, concave
Shape of areas: Irregular or elongated
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 4 inches—very dark gray clay

Subsurface layer:
4 to 18 inches—very dark gray clay

Subsoil:
18 to 38 inches—dark gray clay

Underlying material:
38 to 48 inches—fractured limestone bedrock interbedded with soft marl

Soil Properties

Depth: Moderately deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: Moderate
Root zone: Moderately deep
Natural soil fertility: High
Soil reaction: Slightly alkaline or moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

San Saba soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The shallow Aledo soils along ridges and hilltops
- The clayey Purves and Denton soils along foot slopes and drainageways
- The loamy Bolar soils along foot slopes
- The clayey Crawford and Oglesby soils along ridgetops
- The light colored Brackett soils along breaks and hillsides
- The shallow Eckrant soils along upland flats

Land Uses

Major land use: Cropland
Other land uses: Rangeland, pasture

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- The moderate available water capacity limits the choice of plants to those that are drought tolerant or can produce forage during rainy seasons. Many areas support improved bermudagrass and kleingrass.
- Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.
- Construction of fences is difficult because of the limestone bedrock.

Cropland

Major limitations:
- None

Minor limitations:
- The moderate available water capacity limits the choice of crops to cool-season crops, such as small grain, or short-season, drought-tolerant crop varieties.
- Because of the moderate hazard of water erosion, crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
- None

Minor limitations:
- The moderate available water capacity limits production, especially in dry years.
- Construction of farm ponds is not recommended because of the depth to limestone bedrock and excessive seepage.

Urban development

Major limitations:
- Shrinking and swelling of the soil can cause buildings and roads to crack or buckle.

Minor limitations:
- The very slow permeability can sometimes cause septic systems to fail.
- The moderate available water capacity can add to the cost of maintaining lawns and landscape plants.
- Excavation of the limestone bedrock is difficult.

Interpretive Groups

Land capability classification: IIIe
Range site: Blackland

SgB—Sanger clay, 1 to 3 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping, slightly concave
Shape of areas: Irregular or rounded
Size of areas: 10 to 400 acres

Typical Profile

Surface layer:
0 to 6 inches—dark grayish brown clay

Subsurface layer:
6 to 34 inches—dark grayish brown clay

Subsoil:
34 to 66 inches—grayish brown and light brownish gray clay

Underlying material:
66 to 80 inches—yellow shale with clay texture

Soil Properties

Depth: Very deep to shale
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Medium
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Sanger soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The well drained Lott and McLennan soils on hillsides
- The moderately deep Austin soils on ridgetops
- The well drained, deep Ferris soils on hillsides
- The moderately well drained Houston Black and Slidell soils on the lower foot slopes

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland, wildlife habitat, recreation, urban development

Management Concerns

Pasture

Major limitations:
- None

Minor limitations:
- The very slow permeability can cause temporary wetness during wet periods.
- The soil cracks when dry. The cracking can cause fences to sag.

Cropland

Major limitations:
- None

Minor limitations:
- The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
- Because of the moderate hazard of water erosion, management of crop residue, terraces, or grassed waterways may be needed to prevent excessive soil loss.
- Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
- None

Minor limitations:
- The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
- Shrinking and swelling of the soil can cause houses, sidewalks, roads, and streets to crack or buckle.
- The very slow permeability may cause septic systems to work improperly.
- Establishing lawns and landscape plants is difficult on this clayey soil.
- Shallow excavations sometimes cave in.

Minor limitations:
- The very slow permeability can cause water to accumulate for short periods in some areas.

• Maintenance of lawns and landscape plants is difficult on this clayey soil.

Interpretive Groups

Land capability classification: IIe
Range site: Blackland

Sh—Ships clay, rarely flooded

Setting

Landform: Holocene-age flood plains along the Brazos River
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated or rounded
Size of areas: 20 to 500 acres

Typical Profile

Surface layer:
0 to 10 inches—brown clay

Subsurface layer:
10 to 24 inches—reddish brown clay

Subsoil:
24 to 74 inches—reddish brown clay

Underlying material:
74 to 80 inches—reddish brown silty clay loam

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: Rare, of brief duration
Runoff: Slow
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Ships soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained, loamy Bosque soils on flood plains
• The moderately well drained, clayey Tinn soils on flood plains
• The well drained Sunev and Lewisville soils on bordering hillsides
• The well drained Yahola and Weswood and somewhat excessively drained Gaddy soils in the areas closer to the present-day river

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland, recreation

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The soil is flooded about once every 20 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which can delay farming operations.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.
• Crop losses can occur because of flooding.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
• Shrinking and swelling of the soil can cause houses, roads, and streets to crack or buckle.
• The very slow permeability can cause septic systems to fail.
Minor limitations:
• The very slow permeability and slow runoff can cause water to accumulate on the surface for short periods.

Interpretive Groups

Land capability classification: IIs
Range site: Clayey Bottomland

SsB—Slidell clay, 0 to 2 percent slopes

Setting

Landform: Uplands of Lower Cretaceous age
Distinctive landscape features: None
Landscape position: Foot slopes
Slope: Gently sloping
Shape of areas: Rounded or irregular
Size of areas: 10 to 1,000 acres

Typical Profile

Surface layer:
0 to 9 inches—very dark gray clay

Subsurface layer:
9 to 37 inches—very dark gray clay

Subsoil:
37 to 43 inches—grayish brown clay
43 to 72 inches—light gray silty clay

Underlying material:
72 to 74 inches—light brownish gray marl interbedded with limestone

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Slidell soil and similar inclusions: 90 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The noncalcareous Burleson soils on broad flats
• The well drained Krum and Lewisville soils in the slightly lower positions
• The well drained Sanger soils in the slightly higher positions
• The well drained, moderately deep Bolar, San Saba, and Denton soils in the slightly higher positions

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness during wet periods.
• The soil cracks when dry. The cracking can cause fences to sag.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which can sometimes delay farming operations.
• Because of the moderate hazard of water erosion, management of crop residue, terraces, or grassed waterways may be needed to prevent excessive soil loss.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
• The very slow permeability can cause septic systems to work improperly.
• Establishing lawns and landscape plants is difficult on this clayey soil.
• Shallow excavations sometimes cave in.
Minor limitations:
• The slow runoff and very slow permeability can

cause water to accumulate for short periods.

Interpretive Groups

Land capability classification: IIe
Range site: Blackland

StC—Stephen-Eddy complex, 2 to 5 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: None
Landscape position: Convex hilltops and ridges
Slope: Gently sloping
Shape of areas: Rounded or elongated
Size of areas: 10 to 2,000 acres

Typical Profile

Stephen soil

Surface layer:
0 to 8 inches—dark brown silty clay

Subsoil:
8 to 12 inches—platy chalk interbedded with dark brown silty clay

Underlying material:
12 to 28 inches—pink and white, platy chalk

Eddy soil

Surface layer:
0 to 5 inches—brown gravelly clay loam

Subsoil:
5 to 9 inches—brown gravelly clay loam

Underlying material:
9 to 20 inches—white, platy chalk

Soil Properties

Depth: Very shallow or shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: Very low
Root zone: Very shallow or shallow
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Composition

Stephen soil and similar inclusions: 60 percent
Eddy soil and similar inclusions: 25 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

- The clayey Austin, Fairlie, Houston Black, and Heiden soils on foot slopes
- Rock outcrops along hillsides
- A clayey soil that is similar to the Stephen soil but has a calcium carbonate equivalent of more than 40 percent

Land Uses

Major land use: Rangeland
Other land uses: Cropland, pasture, urban development

Management Concerns

Pasture

Major limitations:
- The very low available water capacity limits production.

Minor limitations:
- Construction of farm ponds is not recommended because of the depth to bedrock and seepage.
- Construction of fences is expensive and difficult because of the chalky bedrock.

Cropland

Major limitations:
- These soils are poorly suited to cropland because of the depth to bedrock and the very low available water capacity.
- These shallow or very shallow soils are easily eroded. A cover of crop residue is needed to control erosion.

Minor limitations:
- None

Rangeland

Major limitations:
- Productivity may be low because of the very shallow or shallow root zone and the very low available water capacity.

Minor limitations:
- Construction of farm ponds is not recommended because of the depth to bedrock and seepage.
- Construction of fences is difficult because of the chalky bedrock.

Urban development

Major limitations:
• Septic systems are difficult to install in the chalky bedrock, and sewage effluent may seep into ground water.
• Lawn and grasses are difficult to establish and maintain on these shallow or very shallow soils.
Minor limitations:
• Excavations for roads and streets are difficult because of the chalky bedrock.

Interpretive Groups

Land capability classification: Stephen soil—IVe; Eddy soil—VIe
Range site: Stephen and Eddy soils—Chalky Ridge

SuD—Stephen-Urban land complex, 2 to 5 percent slopes

Setting

Landform: Uplands of Upper Cretaceous age
Distinctive landscape features: Chalky hillsides and ridges
Landscape position: Hillsides and ridges; convex slopes
Slope: Gently sloping
Shape of areas: Irregular or rounded
Size of areas: 50 to 500 acres

Typical Profile

Stephen soil

Surface layer:
0 to 10 inches—grayish brown silty clay

Subsoil:
10 to 15 inches—grayish brown gravelly silty clay

Underlying material:
15 to 30 inches—white chalk interbedded with chalky marl

Soil Properties

Stephen soil

Depth: Shallow or very shallow
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Rapid
Permeability: Moderately slow
Available water capacity: Very low
Root zone: Shallow or very shallow
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Moderate
Hazard of water erosion: Severe
Hazard of wind erosion: Slight

Characteristics of the Urban Land

The Urban land is covered by dwellings, small buildings, apartments, streets, roads, driveways, parking lots, and other structures. Some areas have been cut and shaped for building sites. Because the original soil was used when most cuts and fills were made, the thickness of horizons in the existing profile may vary widely. The basic characteristics of the soil, however, remain the same. In many places imported soil material was used for leveling.

Composition

Stephen soil and similar inclusions: 50 percent
Urban land and similar inclusions: 40 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The very shallow, well drained Eddy soils along ridgetops and hillsides
• The deep, moderately well drained Fairlie soils on foot slopes
• The deep, well drained Heiden and Ferris soils on hillsides and foot slopes
• The moderately deep, well drained Austin soils on foot slopes
• A soil that is similar to the Stephen soil but has a calcium carbonate equivalent of more than 40 percent

Land Uses

Major land use: Urban development
Other land uses: Recreation, pasture

Management Concerns

Pasture

Major limitations:
• Because of urban development, this unit generally is not used as pasture.
• The very low available water capacity limits production.
Minor limitations:
• None

Cropland

Major limitations:
• Because of urban development, this unit generally

is not used as cropland.
Minor limitations:
• None

Rangeland

Major limitations:
• Because of urban development, this unit generally is not used as rangeland.
Minor limitations:
• Construction of farm ponds is not recommended because of the limited depth to bedrock and seepage.

Urban development

Major limitations:
• Effluent filtration is poor and ground-water contamination is possible in areas used for septic tank absorption fields.
• The very low available water capacity adversely affects lawns, gardens, and landscape plants.
Minor limitations:
• Excavation of the chalky bedrock is difficult.

Interpretive Groups

• None assigned

SyB—Styx loamy fine sand, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age terraces along the Brazos River
Distinctive landscape features: Mounded or plane
Landscape position: Hillsides and foot slopes
Slope: Gently sloping
Shape of areas: Rounded or irregular
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 8 inches—light yellowish brown loamy fine sand

Subsurface layer:
8 to 27 inches—brownish yellow loamy fine sand

Subsoil:
27 to 55 inches—reddish yellow, red, and light gray sandy clay loam

Underlying material:
55 to 80 inches—reddish yellow, red, and light gray sandy clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: Perched at a depth of 4 to 6 feet, mostly during winter and spring
Flooding: None
Runoff: Slow
Permeability: Moderate
Available water capacity: Moderate.
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Strongly acid to neutral in the surface layer, subsurface layer, and subsoil
Shrink-swell potential: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Severe

Composition

Styx soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained Bastsil soils along ridges breaking to the lower elevations
• The moderately well drained Chazos soils along foot slopes and broad ridges
• The moderately well drained Mabank soils in depressions
• The somewhat excessively drained Desan soils along ridges
• The well drained Dutek soils along hillsides

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production and restricts the choice of plants to those that are drought tolerant. Many areas support improved bermudagrass.
• Construction of farm ponds is not recommended because of excessive seepage.

Cropland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits

production. The major crops are peanuts and truck crops.
• Because of the hazards of water erosion and wind erosion, crop residue should be left on the surface to prevent excessive soil loss and maintain the content of organic matter.

Rangeland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity limits production in dry years.
• Construction of farm ponds is not recommended because of excessive seepage.

Urban development

Major limitations:
• Seepage of effluent through the moderately permeable subsoil and into ground water is possible in areas used for septic tank absorption fields.
Minor limitations:
• Because of the moderate available water capacity and the sandy surface layer, establishing and maintaining lawns and landscape plants may be difficult.

Interpretive Groups

Land capability classification: IIIe
Range site: Sandy

SzB—Sunev clay loam, 1 to 3 percent slopes

Setting

Landform: Pleistocene-age terraces along the Bosque River and local streams
Distinctive landscape features: None
Landscape position: Foot slopes and terrace flats
Slope: Gently sloping
Shape of areas: Rounded or elongated
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 10 inches—brown clay loam

Subsurface layer:
10 to 19 inches—brown clay loam

Subsoil:
19 to 32 inches—pink clay loam
32 to 42 inches—very pale brown loam
42 to 80 inches—very pale brown clay loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: None
Runoff: Slow
Permeability: Moderate
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Sunev soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The moderately well drained Branyon soils on broad flats
• Bosque and Frio soils along narrow flood plains
• The well drained Krum and Lewisville soils on flats, breaks, and alluvial flood plains
• Small areas of the well drained Lamar soils near landscape breaks
• The well drained, shallow Aledo soils along hillsides

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• Construction of farm ponds is not recommended because of possible seepage in the loamy subsoil layers.
• The moderate available water capacity may slightly reduce yields in some years.

Cropland

Major limitations:
• None
Minor limitations:
• Because of the moderate hazard of water erosion, cropping systems that leave large amounts of crop residue on the surface are needed to prevent

excessive soil loss and maintain the content of organic matter.
• The moderate available water capacity may limit yields.

Rangeland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity may limit production.
• Construction of farm ponds is not recommended because of seepage.

Urban development

Major limitations:
• Seepage of effluent into ground water is possible in areas used for septic tank absorption fields.
Minor limitations:
• Because of the moderate available water capacity, additional water may be needed to maintain lawns and landscape plants.

Interpretive Groups

Land capability classification: IIe
Range site: Clay Loam

Tn—Tinn clay, rarely flooded

Setting

Landform: Holocene-age flood plains along local streams
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated
Size of areas: 20 to 1,000 acres

Typical Profile

Surface layer:
0 to 5 inches—dark gray clay

Subsurface layer:
5 to 40 inches—dark brown clay

Subsoil:
40 to 80 inches—dark yellowish brown clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: Rare, of brief duration
Runoff: Very slow
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Tinn soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained, clayey Frio soils on flood plains
• The well drained, loamy Bosque soils on flood plains
• The moderately well drained, clayey Ships soils on flood plains
• The well drained Sunev and Lewisville soils on hillsides
• The well drained Yahola and Weswood and somewhat excessively drained Gaddy soils in the areas closer to the present-day Brazos River
• A soil that is similar to the Tinn soil but has red clay below a depth of 40 inches

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The soil is flooded about once every 20 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness, which can delay farming operations.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

• Crop losses can occur because of flooding.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
• Shrinking and swelling of the soil can cause houses, roads, and streets to crack or buckle.
• The very slow permeability can cause septic systems to fail.
Minor limitations:
• The very slow permeability and slow runoff can cause water to accumulate on the surface for short periods.

Interpretive Groups

Land capability classification: IIw
Range site: Clayey Bottomland

To—Tinn clay, frequently flooded

Setting

Landform: Holocene-age flood plains along local streams
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated or rounded
Size of areas: 20 to 1,000 acres

Typical Profile

Surface layer:
0 to 8 inches—dark gray clay

Subsurface layer:
8 to 16 inches—very dark gray clay

Subsoil:
16 to 55 inches—very dark gray and grayish brown clay

Underlying material:
55 to 80 inches—light gray clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None within a depth of 6 feet
Flooding: Frequent, of brief duration
Runoff: Very slow
Permeability: Very slow
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Very high
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Tinn soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained, clayey Frio soils on flood plains
• The well drained, loamy Bosque soils on flood plains
• The moderately well drained, clayey Ships soils on hillsides
• The well drained Sunev and Lewisville soils on hillsides
• The well drained Yahola and Weswood and somewhat excessively drained Gaddy soils in the areas closer to the present-day Brazos River

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, recreation

Management Concerns

Pasture

Major limitations:
• The soil is flooded about once every 2 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.
Minor limitations:
• None

Cropland

Major limitations:
• The frequent floods can destroy fences and crops, cause scour erosion, or deposit sediment on crops.
Minor limitations:
• The very slow permeability can cause temporary wetness, which can delay farming operations.
• Water enters the dry, cracked soil rapidly until the soil becomes sufficiently moist to swell and close the cracks, after which water enters the soil very slowly.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability can cause temporary wetness.

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
• Shrinking and swelling of the soil can cause houses, roads, and streets to crack or buckle.
• The very slow permeability can cause septic systems to fail.
Minor limitations:
• The very slow permeability and very slow runoff can cause water to accumulate on the surface for short periods.

Interpretive Groups

Land capability classification: Vw
Range site: Clayey Bottomland

Ur—Urban land

Setting

Landform: Variable
Distinctive landscape features: None
Landscape position: Variable
Shape of areas: Variable
Size of areas: 20 to 2,000 acres

Characteristics of the Urban Land

Urban land consists of several soils in areas where more than 85 percent of the surface typically is covered by office buildings, shopping centers, hotels, churches, schools, hospitals, dwellings, small buildings, apartments, streets, roads, driveways, parking lots, and other structures. Included in some areas are small vacant lots, grassed areas, dwellings, and soils covered with fill material. Some areas have been cut and shaped for building sites. Because the original soil was used when most cuts and fills were made, the thickness of horizons in the existing profile may vary widely. Most of the educational, entertainment, and governmental functions in the county are in these areas.

Runoff is very rapid in these areas, and most of the rainfall reaches the major drains quickly.

Interpretive Groups

Land capability classification: VIIIs
Range site: None assigned

Wd—Weswood silt loam, rarely flooded

Setting

Landform: Holocene-age flood plains along the Brazos River
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated or slightly rounded
Size of areas: 10 to 500 acres

Typical Profile

Surface layer:
0 to 6 inches—reddish brown silt loam

Subsoil:
6 to 18 inches—reddish brown silt loam
18 to 44 inches—yellowish red silt loam

Underlying material:
44 to 80 inches—reddish yellow silt loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: Rare, of very brief or brief duration
Runoff: Slow
Permeability: Moderate
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Weswood soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The sandier Yahola and Gaddy soils in the areas closer to the present-day Brazos River
• The moderately well drained, clayey Ships soils in the slightly lower positions
• A soil that is similar to the Weswood soil but has clayey layers in the subsoil and is in the slightly lower positions

• Small areas of Weswood soils with a surface layer of silty clay loam

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland, recreation

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• This soil is flooded about once every 20 years. Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.
• Construction of farm ponds is not recommended because of seepage.

Cropland

Major limitations:
• None
Minor limitations:
• Floods are rare, but they cause crop losses when they occur.

Rangeland

Major limitations:
• None
Minor limitations:
• None

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
Minor limitations:
• Seepage of effluent into ground water is possible in areas used for septic tank absorption fields.

Interpretive Groups

Land capability classification: I
Range site: Loamy Bottomland

We—Weswood silty clay loam, rarely flooded

Setting

Landform: Holocene-age flood plains along the Brazos River
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated or slightly rounded
Size of areas: 10 to 500 acres

Typical Profile

Surface layer:
0 to 8 inches—reddish brown silty clay loam

Subsoil:
8 to 20 inches—reddish brown silty clay loam
20 to 40 inches—yellowish red silt loam

Underlying material:
40 to 65 inches—reddish yellow very fine sandy loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: Rare, of very brief or brief duration
Runoff: Slow
Permeability: Moderate
Available water capacity: High
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Weswood soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The sandier Yahola and Gaddy soils in the areas closer to the present-day Brazos River
• The moderately well drained, clayey Ships soils in the slightly lower positions
• A soil that is similar to the Weswood soil but has clayey subsoil layers and is in the slightly lower positions
• Small areas of Weswood soils with a surface layer of silt loam

Land Uses

Major land use: Cropland
Other land uses: Pasture, rangeland, recreation

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• This soil is flooded about once every 20 years.

Floods can destroy fences, cause scour erosion, and deposit sediment on established pastures.

Cropland

Major limitations:
• None
Minor limitations:
• Floods are rare, but they can damage crops when they occur.

Rangeland

Major limitations:
• None
Minor limitations:
• None

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, or other urban structures.
Minor limitations:
• Seepage of effluent into ground water is possible in areas used for septic tank absorption fields.

Interpretive Groups

Land capability classification: I
Range site: Loamy Bottomland

WnA—Wilson clay loam, 0 to 2 percent slopes

Setting

Landform: Stream terraces of Pleistocene age
Distinctive landscape features: None
Landscape position: Broad flats
Slope: Nearly level or gently sloping
Shape of areas: Irregular or rounded
Size of areas: 10 to 500 acres

Typical Profile

Surface layer:
0 to 8 inches—dark grayish brown clay loam

Subsoil:
8 to 18 inches—dark gray clay
18 to 32 inches—very dark gray clay
32 to 65 inches—dark gray and grayish brown clay

Underlying material:
65 to 80 inches—reddish yellow clay

Soil Properties

Depth: Very deep
Drainage class: Moderately well drained
Water table: None; however, may be saturated above the subsoil for short periods after heavy rainfall
Flooding: None
Runoff: Slow
Permeability: Very slow
Available water capacity: Moderate
Root zone: Deep
Natural soil fertility: Medium
Soil reaction: Moderately acid to neutral in the surface layer, moderately acid to slightly alkaline in the upper part of the subsoil, and neutral to moderately alkaline in the lower part of the subsoil
Shrink-swell potential: High
Hazard of water erosion: Moderate
Hazard of wind erosion: Slight

Composition

Wilson soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• Mabank soils, which have a surface layer of fine sandy loam and are on slight mounds
• The moderately well drained Axtell soils on the slightly higher ridges
• The moderately well drained Crockett and well drained Lamar soils on hillsides
• The moderately well drained Bremond soils in the slightly higher positions
• The moderately well drained Burleson soils in the slightly lower positions

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, recreation, urban development

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The very slow permeability in the subsoil limits water infiltration and root penetration.
• The moderate available water capacity limits the production of forage.

Cropland

Major limitations:
• None
Minor limitations:
• The very slow permeability in the subsoil limits the

penetration of water and plant roots.
• Because of the medium natural fertility and a low content of organic matter, the soil is crusty and difficult to cultivate when dry.
• The moderate available water capacity limits crop yields.
• Because of the moderate hazard of water erosion, crop residue should be left on the surface to prevent excessive soil loss.
• In wet years the very slow permeability and slow runoff can cause temporary wetness.

Rangeland

Major limitations:
• None
Minor limitations:
• The very slow permeability limits the penetration of water and plant roots.
• The moderate available water capacity limits production.

Urban development

Major limitations:
• The very slow permeability and slow runoff can cause septic systems to fail in wet periods.
• Shrinking and swelling of the soil can cause houses, roads, streets, and sidewalks to crack or buckle.
Minor limitations:
• The slow runoff and very slow permeability can cause water to accumulate on yards or streets for short periods.

Interpretive Groups

Land capability classification: IIIe
Range site: Claypan Prairie

Ya—Yahola loam, rarely flooded

Setting

Landform: Holocene-age flood plains along the Brazos River
Distinctive landscape features: None
Landscape position: Bottomland
Slope: Nearly level
Shape of areas: Elongated or slightly rounded
Size of areas: 10 to 300 acres

Typical Profile

Surface layer:
0 to 12 inches—brown loam

Underlying material:
12 to 28 inches—reddish brown very fine sandy loam
28 to 42 inches—yellowish red very fine sandy loam stratified with loamy fine sand
42 to 65 inches—reddish yellow loamy fine sand stratified with very fine sandy loam

Soil Properties

Depth: Very deep
Drainage class: Well drained
Water table: None within a depth of 6 feet
Flooding: Rare, of brief duration
Runoff: Slow
Permeability: Moderately rapid
Available water capacity: Moderate
Root zone: Very deep
Natural soil fertility: High
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Yahola soil and similar inclusions: 85 percent
Contrasting inclusions: 15 percent

Contrasting Inclusions

• The well drained, loamy Weswood soils in slight depressions
• The moderately well drained, clayey Ships soils in slight depressions
• The sandy Gaddy soil near banks of the Brazos River

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, recreation

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The moderate available water capacity may limit production in some years.
• Construction of farm ponds is not recommended because of seepage.
• Floods are rare on this soil, but they can occur.

Cropland

Major limitations:
• None
Minor limitations:
• The moderate available water capacity may limit yields.

• Flooding is rare, but it can destroy crops when it occurs.

Rangeland

Major limitations:
• None
Minor limitations:
• None

Urban development

Major limitations:
• Flooding is a severe hazard on sites for streets, houses, and other urban structures.
Minor limitations:
• Seepage of effluent into ground water is possible in areas used for septic tank absorption fields.

Interpretive Groups

Land capability classification: IIe
Range site: Loamy Bottomland

Yg—Yahola-Gaddy complex, occasionally flooded

Setting

Landform: Holocene-age flood plains along the Brazos River
Distinctive landscape features: Stepped riverbanks
Landscape position: Flood plains
Slope: Nearly level or gently sloping
Shape of areas: Elongated
Size of areas: 10 to 100 acres

Typical Profile

Yahola soil

Surface layer:
0 to 10 inches—pale brown very fine sandy loam

Underlying material:
10 to 42 inches—reddish yellow very fine sandy loam
42 to 80 inches—yellowish red loamy fine sand with common strata of fine sandy loam

Gaddy soil

Surface layer:
0 to 8 inches—light yellowish brown loamy fine sand

Underlying material:
8 to 80 inches—very pale brown fine sand

Soil Properties

Depth: Very deep
Drainage class: Yahola—well drained; Gaddy—somewhat excessively drained
Water table: None within a depth of 6 feet
Flooding: Occasional, of brief duration
Runoff: Slow
Permeability: Moderately rapid
Available water capacity: Yahola—moderate; Gaddy—low
Root zone: Very deep
Natural soil fertility: Low
Soil reaction: Moderately alkaline
Shrink-swell potential: Low
Hazard of water erosion: Slight
Hazard of wind erosion: Slight

Composition

Yahola soil and similar inclusions: 65 percent
Gaddy soil and similar inclusions: 25 percent
Contrasting inclusions: 10 percent

Contrasting Inclusions

• The moderately well drained, clayey Ships soils in depressions
• The well drained, loamy Weswood soils in the slightly higher positions

Land Uses

Major land use: Pasture
Other land uses: Cropland, rangeland, orchards

Management Concerns

Pasture

Major limitations:
• None
Minor limitations:
• The occasional floods can damage fences and grasses, cause scour erosion, or deposit sediment on pastures.
• Construction of ponds is not recommended because of seepage.

Cropland

Major limitations:
• None
Minor limitations:
• Because of the complex pattern of soils, managing cropland is difficult.
• The low available water capacity in the Gaddy soil

and moderate available water capacity of Yahola soil may limit yields.
• The occasional floods can damage crops.

Rangeland

Major limitations:
• None
Minor limitations:
• None

Urban development

Major limitations:
• Although most areas of these soils are protected by dams on the Brazos River and other watersheds, occasional floods can occur. They can damage roads, houses, and other urban structures.
Minor limitations:
• Because of the low available water capacity in the Gaddy soil and moderate available water capacity in the Yahola soil, establishing and maintaining yards may be difficult.

Interpretive Groups

Land capability classification: Yahola soil—IIw; Gaddy soil—IVs
Range site: Yahola soil—Loamy Bottomland; Gaddy soil—Sandy Bottomland

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pasture, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 317,000 acres in the survey area, or nearly 47 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the southern and eastern parts, mainly in general soil map units 1, 2, 4, 5, 7, 10, 11, 12, 13, 14, and 16, which are described under the heading "General Soil Map Units." About 150,000 acres of this prime farmland is used for crops. The crops grown on this land, mainly corn, cotton, wheat, oats, and forage sorghum, account for an estimated one-half of the county's total agricultural income each year.

A recent trend in land use in some parts of the survey area has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed at the end of this section. This list does not constitute a recommendation for a particular land use. On some soils included in the list, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The map units that meet the requirements for prime farmland are:

AsB	Austin silty clay, 1 to 3 percent slopes
BaA	Bastsil fine sandy loam, 0 to 2 percent slopes
Bh	Bosque clay loam, occasionally flooded
BnA	Branyon clay, 0 to 1 percent slopes
BnB	Branyon clay, 1 to 3 percent slopes
BuA	Burleson clay, 0 to 1 percent slopes
CaB	Chazos loamy fine sand, 1 to 3 percent slopes
CfB	Crawford clay, 0 to 2 percent slopes
DeB	Denton silty clay, 1 to 3 percent slopes
FaB	Fairlie clay, 1 to 3 percent slopes
Fr	Frio silty clay, occasionally flooded
HeB	Heiden clay, 1 to 3 percent slopes
HeC	Heiden clay, 3 to 5 percent slopes
HgB	Heiden gravelly clay, 1 to 3 percent slopes
HoB	Houston Black clay, 1 to 3 percent slopes
LeB	Lewisville silty clay, 1 to 3 percent slopes
LoB	Lott silty clay, 1 to 5 percent slopes
MnB	Minwells fine sandy loam, 1 to 3 percent slopes
SaB	San Saba clay, 0 to 2 percent slopes
SgB	Sanger clay, 1 to 3 percent slopes
Sh	Ships clay, rarely flooded

SsB	Slidell clay, 0 to 2 percent slopes
SzB	Sunev clay loam, 1 to 3 percent slopes
Tn	Tinn clay, rarely flooded
Wd	Weswood silt loam, rarely flooded
We	Weswood silty clay loam, rarely flooded
Ya	Yahola loam, rarely flooded

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Baker H. Davis, district conservationist, Natural Resources Conservation Service, Waco, Texas, prepared this section.

During the long period that the soils in McLennan County have been used for crops and forage, two principles of soil management have evolved. One of these is the need to protect the soil from water erosion, and the other is the need to maintain and improve tilth. The amount and distribution of rainfall, periods of drought, and high winds are concerns of soil management in the county.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading “Detailed Soil Map Units.” Specific information can be obtained from the local office of the Natural Resources Conservation Service.

According to records of the local office of the Natural Resources Conservation Service, more than 363,000 acres in the survey area was used for crops, pasture, or rangeland in 1988. Of this total 136,000 acres was used as permanent pasture; 74,000 acres as rangeland; 66,000 acres for row crops, mainly cotton, corn, and grain sorghum (fig. 11); 87,000 acres for close-grown crops, mainly wheat, oats, and forage sorghum.

Water erosion is the major problem on about two-thirds of the cropland and pasture in McLennan County. Loss of the surface layer by erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging to soils that have a clayey subsoil, such as Axtell, Bremond, and Wilson soils, and to shallow or very shallow soils with a rock layer in or below the subsoil that limits the rooting depth. Aledo, Eddy, and Stephen soils, for example, are shallow or very shallow to bedrock. Erosion also reduces the productivity of soils that tend to be droughty, such as Wilson and Mabank soils. Second, erosion of farmland results in the sedimentation of streams. Controlling erosion minimizes this pollution and improves the quality of water for municipal use, recreation, and wildlife.

The results of effective erosion-control practices are a protective surface cover, a reduced amount of runoff, and an increased rate of water infiltration. A cropping system that keeps a vegetative cover on the surface for extended periods holds soil losses to amounts that

Figure 11.—Cotton and corn growing on Houston Black clay, 1 to 3 percent slopes. These crops are commonly grown in a rotation cropping system.

maintain the productive capacity of the soil. On livestock farms, which require pasture and hay, forage crops of legumes and grasses in the cropping system reduce the hazard of erosion on sloping land and provide nitrogen and improve tilth for the next crop.

Slopes are so short and irregular that contour tillage or terracing is not practical in most areas of the strongly sloping McLennan, Ferris, and Lott soils. On these soils cropping systems that provide a substantial vegetative cover are required to control erosion unless minimum tillage is used. Minimizing tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most of the soils in the survey area, but they are less successful on the eroded soils and on the soils that have a clayey surface layer.

Terraces and diversions reduce the length of slopes and thus help to control runoff and erosion. They are most practical on deep, well drained soils that have regular slopes. Austin, Branyon, Burleson, Heiden, Houston Black, Lewisville, Lott, Sanger, and Slidell soils are suitable for terraces. The other soils in the county are not as well suited to terraces and diversions because of irregular slopes, excessive wetness in the terrace channels, a clayey subsoil that would be exposed in the terrace channels, bedrock at a depth of less than 40 inches, or flooding.

Contour farming, terraces, and grassed waterways are widespread erosion-control practices in the survey area (fig. 12). These practices are best adapted to soils that have smooth, uniform slopes, including most Heiden, Houston Black, Sanger, Slidell, Burleson, and Branyon soils.

Wind erosion is a hazard on the sandy Desan, Chazos, Styx, and Dutek soils. Strong winds can damage these soils in a few hours if the soils are dry and have no vegetation or surface mulch. Maintaining a vegetative cover or surface mulch and keeping the surface rough by proper tillage minimize wind erosion.

Information about erosion-control practices for each kind of soil can be obtained at the local office of the Natural Resources Conservation Service.

Drainage is not a problem on most of the soils in the county. The very slow permeability of the Tinn, Mabank, and Wilson soils can cause temporary wetness, which can delay farming operations. Branyon, Burleson, and Houston Black soils have good natural drainage most of the year, but they tend to dry out slowly after rains. Small areas of wetter soils are along drainageways and in swales in areas of the moderately well drained Ships and Ovan soils. Information about the design of drainage systems for each kind of soil is available at the local office of the Natural Resources Conservation Service.

Fertility is naturally high in most soils on flood plains, such as Ovan, Ships, Tinn, Gaddy, and Weswood soils. Many of the slightly alkaline or moderately alkaline soils on uplands, such as Branyon, Heiden, Houston Black, Lewisville, and Lott soils, also are high in natural fertility. McLennan, Ellis, Ferris, Mabank, and Wilson soils, which are on uplands and high terraces, are slightly alkaline or

Figure 12.—Corn and grain sorghum growing on Houston Black clay, 1 to 3 percent slopes. Grassed waterways are used extensively in cultivated areas to protect drainageways from erosion.

moderately alkaline. Their natural fertility is low or medium. The slightly acid Chazos and Desan soils and the moderately acid or strongly acid Axtell, Dutek, and Bremond soils are low in natural fertility.

The slightly alkaline or moderately alkaline soils in the county require applications of nitrogen and phosphorus fertilizer. The slightly acid to strongly acid soils require a split application of a complete fertilizer to keep soil moisture and fertility in balance and prevent the loss of nutrients by leaching. On all soils additions of fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer to be applied.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. Annual additions of crop residue help to maintain the content of organic matter and soil tilth.

Most of the soils used for crops in the survey area have a dark surface layer of clay or silty clay with a moderate or high content of organic matter. Generally, such soils have moderate structure. They are difficult to work because they are sticky when wet and extremely hard when dry. Good seedbeds are difficult to prepare. If plowed when wet, the soils tend to be very cloddy when dry. Dense plowpans can form in cultivated soils. They impede the downward movement of water and the penetration of plant roots. Fall plowing generally results in good tilth in spring.

Fall plowing generally is not a good practice on the light colored soils that have a surface layer of silt loam, silty clay loam, clay loam, or fine sandy loam. A crust forms on these soils during winter and spring. The crust is hard when dry, and it is nearly impervious to water. It reduces the rate of water infiltration and increases the amount of runoff. Regular additions of crop residue, manure, or other organic material minimize crust formation and improve soil structure. Keeping crop residue on the surface helps to control erosion.

The field crops suited to the soils and climate of the survey area include cotton, grain sorghum, and corn. Wheat, oats, and forage sorghum are the most common close-growing crops. Alfalfa is grown on a few soils. Specialty crops are grown commercially in areas along both sides of the Brazos River. These crops include melons, tomatoes, and other vegetables. The soils in these areas can be used for other specialty crops, such as strawberries, blackberries, peaches, pecans, and many vegetables.

Deep, loamy soils that have slopes of less than 5 percent have good natural drainage, and they warm up early in spring. They are especially well suited to many vegetables and small fruits. Crops generally can be planted and harvested earlier on these soils than on other soils. Soils at low elevations, where frost is frequent and air circulation is poor, generally are poorly suited to early vegetables, small fruits, and orchards.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Natural Resources Conservation Service.

Sound practices of grazing management are needed to achieve sustained high production of grasses in areas of pasture. Grasses should be given a period of recovery after they have been grazed. During the growing season, a sufficient amount of leaf surface must be left on a plant to permit the plant to rapidly manufacture food in its leaves. Leaving a good supply of plant material on the surface helps to control erosion, improves tilth, and helps to protect the plant from extremes in temperature.

Other management practices, such as applications of fertilizer, weed control, and rotational grazing, are important. Fertilizer should be applied in the amount indicated by a soil test and the needs of the plants. The combination of grasses and legumes in pastures can be regulated, in part, by the time of fertilization. Applying fertilizer in fall favors legumes, and applying it in spring favors grasses. Weed control is less of a concern on well managed, properly grazed pasture than on poorly managed, overgrazed pasture. A good ground cover restricts the growth of undesirable plants. Plants in areas of improved pasture can be adversely affected if weeds are not controlled early.

Because of the slope, the depth to bedrock, and the hazard of erosion, many of the soils in the county are better suited to pasture or hay than to cultivated crops. Many areas that are suitable for cultivation are used for hay or pasture, and areas that were once cultivated are being converted to improved pasture and hayland. An improved pasture or meadow is one in which grasses are introduced into the plant community to obtain high production of forage.

The most important grasses in the areas of pasture and hay are coastal bermudagrass (fig. 13) and common bermudagrass. These grasses grow better on the deeper soils, such as Austin, Branyon, Burleson, Houston Black, and Tinn soils, than on shallow soils. Other grasses generally planted in areas of hay and pasture are johnsongrass, King Ranch bluestem, Kleberg bluestem, and kleingrass. Several native grasses, such as indiangrass and switchgrass, respond to intensive management and are suitable for pasture and hay.

Figure 13.—Cattle grazing coastal bermudagrass pasture on Bastsil fine sandy loam, 0 to 2 percent slopes. Coastal bermudagrass is the most commonly grown improved pasture grass in the county.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations also are considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared

with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section “Detailed Soil Map Units” and in the yields table.

Rangeland

Homer Sanchez, area range conservationist, Natural Resources Conservation Service, Temple, Texas, prepared this section.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil that supports rangeland vegetation suitable for grazing, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table also are important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing

animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Rangeland is land on which the native vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. Rangeland or native grassland receives no regular or frequent cultural treatment, such as applications of fertilizer and tillage.

Approximately 74,057 acres in McLennan County, or about 11 percent of the total acreage, is classified as rangeland. Most of the county was once an open prairie, where trees grew only along streams and in scattered motts on the adjacent uplands. The eastern three-fourths of the county is in the Texas Blackland Prairie *(19)*, a gently rolling prairie underlain by marl, calcareous clay, and chalk. The western part of the county is in the Grand Prairie *(19)*, a rolling prairie with soils that formed in material weathered from limestone.

The rangeland plant community in the county has changed significantly over the last century. Forage quality and production have decreased as a result of several factors. Wildfires, which burned thousands of acres at a time, were effective in keeping woody species in check. Control of wildfires and livestock grazing pressure have resulted in a shift from a grassland prairie for the most part to a shrub- or tree-dominated overstory. Current conditions dictate a climax community that may lack the biodiversity that was evident in the past.

The increase in brush density and heavier stocking rates have resulted in the deterioration of grasslands to the point where many of the taller grasses have been grazed out. Tall grasses flourish only in a few areas. They have been replaced by a mixture of short and mid grasses and poor-quality forbs. Remnants of the original plant community still grow in some areas. In most places the high-quality plants can be reestablished by good grazing management.

Most of the ranches and livestock farms in the county are cow-calf operations. These are some stocker calf enterprises, and many ranches supplement their income by running stocker calves on small grain pasture in the winter. This practice permits greater flexibility in adjusting livestock numbers during periods of drought and of grazing stress.

Most of the livestock operations supplement the grazing of rangeland with improved pastures, forage crops, and supplemental feed. Improved bermudagrass, kleingrass, and King Ranch bluestem are commonly grown as improved pasture grasses. Hay and small grain generally are grown in cultivated areas.

Most of the forage on rangeland is produced during two distinct growth periods. Approximately 70 percent of the annual growth is produced in April, May, and June, when spring rains and moderate temperatures favor the growth of warm-season plants. The second growth period is in September and October, when fall rains coincide with gradually cooling temperatures.

Droughts of varying duration are frequent in the survey area. Short midsummer droughts are normal, but droughts that last for several months also occur.

The condition or health of rangeland is measured by comparing the composition of the current vegetation to the expected composition under climax conditions. Range sites are the key factors used to evaluate and monitor the condition and health of native lands.

Range sites are subject to many influences that modify or even temporarily destroy vegetation. Examples of such influences are drought, overgrazing, wildfires, and short-term tillage. If the conditions resulting from these influences are not too severe, the

plant community will recover and return to climax conditions. Severe site deterioration, however, may permanently alter the potential of the site.

Climax vegetation on the range site is the stabilized plant community that reproduces itself and changes very little so long as the environment remains unchanged. Throughout the survey area, the climax vegetation consists of the plants that grew in the area when it was first settled. The most productive combination of forage plants on a range site is generally the climax vegetation.

The plant community can include decreasers, increasers, and invaders. *Decreasers* are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreasers are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that cannot compete with the climax vegetation for moisture, nutrients, and light. They invade and grow along with the increasers after the amount of the climax vegetation has been reduced by grazing.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. The classes show the present condition of the native vegetation on a range site in relation to the native vegetation that could grow on the site. A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

Potential forage production depends on the kind of range site. Current forage production depends on the range condition and the moisture available to plants during the growing season.

Good production of livestock and forage on rangeland is obtained primarily by managing the time of grazing and limiting the amount of forage removed. The green parts of plants manufacture food for growth and store part of it for use in regrowth and seed production.

Following years of prolonged overuse of rangeland, seed sources of desirable vegetation are eliminated. The vegetation can be reestablished by applying one or a combination of the following practices—mechanical or chemical treatment, range seeding, fencing, water development, prescribed burning, or other treatments that revitalize stands of native plants. Thereafter, deferred grazing, proper grazing use, and planned grazing systems are needed to maintain or improve the rangeland. The implementation of physical practices must be followed by grazing management and follow-up brush control for maintenance purposes. The combination of alternatives, or resource management systems, is essential if rangeland productivity is to be maintained. Following are some of the more commonly used resource management practices.

Proper grazing use.—The objective of this practice is a grazing intensity that maintains enough cover to protect the soil and maintain or improve the quality and quantity of desirable vegetation.

Deferred grazing.—This practice is the deferment or restriction of grazing until the better plants have completed most of their seasonal growth or have made seed. It is one way to help keep the desirable plants healthy and vigorous. It also permits plants that have been depleted to become strong again. Deferred grazing helps to improve plant cover and reduce soil erosion.

Fencing.—This practice excludes livestock from areas that should be protected from grazing, confines livestock to an area, subdivides grazing land to permit use of a planned grazing system, and protects new seedlings or plantings from grazing.

Prescribed burning.—Livestock operators and wildlife managers periodically use this practice to burn off a dense cover of mature vegetation. When done properly and at the right time, the practice stimulates new succulent growth for both cattle and wildlife, increases the availability of forage, restores climax plant species on uplands, and controls infestations of noxious weed and brush species. Forage can be severely damaged by burning during periods when the surface of the soil is dry because fire can reach the plant crowns and roots and kill the plants. Burning more often than once every 3 years may harm the perennial grass vegetation. Prescribed burning is an effective management tool that can substitute for chemical or mechanical treatments in many plant communities. It can be very effective in controlling the regrowth of juniper and other nonsprouting brush species. All burning requires adequate deferment for necessary fuel loads and, more importantly, should be preceded by a complete prescribed burn management plan designed by qualified personnel.

Planned grazing systems.—The objective of this practice is to rotate livestock grazing on two or more pastures in a planned sequence for a period of years and thus meet the deferred grazing needs of the plant community and the nutritional needs of the livestock. A

planned grazing system may be relatively simple in design, using two pastures, or may be more complex and management intensive, using one or two herds and numerous pastures. It must be tailored to each ranch unit and meet the needs of the plants and animals and the goals of the ranchers.

The range sites in this survey area are Blackland, Chalky Ridge, Clay Loam, Clayey Bottomland, Claypan Prairie, Claypan Savannah, Deep Redland, Deep Sand, Eroded Blackland, Gravelly, Loamy Bottomland, Low Stony Hill, Sandy, Sandy Bottomland, Sandy Loam, Shallow, Shallow Clay, and Steep Adobe.

Blackland range site. The Branyon, Burleson, Fairlie, Heiden, Houston Black, San Saba, Sanger, and Slidell soils in map units BnA, BnB, BuA, FaB, HeB, HeC, HeD, HgB, HoB, SaB, SgB, and SsB are in the Blackland range site. The climax vegetation is a tall grass prairie with a few large live oak, elm, and hackberry trees along drainageways and in motts. The composition, by weight, is 85 percent grasses, 5 percent woody plants, and 10 percent forbs. This site has high natural fertility.

Little bluestem, indiangrass, and big bluestem produce 75 percent of the forage in the climax plant community. Other grasses, such as switchgrass, eastern gamagrass, sideoats grama, Texas wintergrass, Texas cupgrass, tall dropseed, Florida paspalum, and Virginia wildrye, make up 10 percent. Woody plants are live oak, elm, hackberry, bumelia, and coralberry. Many palatable forbs and legumes are native to the site.

Overgrazing by cattle eventually kills out tall grasses, such as big bluestem, indiangrass, switchgrass, and eastern gamagrass. These are replaced by silver bluestem, Texas wintergrass, tall dropseed, and other mid grasses. If continued grazing pressure occurs, buffalograss, Texas grama, tumblegrass, annual weeds, and annual grasses dominate the site and an invasion of noxious brush species, such as mesquite, elm, and baccharis, occurs.

Chalky Ridge range site. The Eddy, Queeny, and Stephen soils in map units EdD, QuC, and StC are in the Chalky Ridge range site. This is a true prairie site. Large live oak trees, which grow either singly or in small motts, shade less than 10 percent of the ground. The scattered trees, rolling topography, and many native flowering forbs make this an attractive site. The composition, by weight, is 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The herbaceous plant community is dominated by little bluestem, which generally produces as much as 65 percent of the total annual yield. Indiangrass, big bluestem, Canada wildrye, and Virginia wildrye also are very important and many times dominate the site. Sideoats grama, silver bluestem, and tall dropseed are the mid grasses, which occur in smaller amounts. Many forbs and legumes provide valuable grazing and beauty to the site.

As retrogression occurs, the tall grass species decrease in abundance and are replaced by sideoats grama, Texas wintergrass, silver bluestem, buffalograss, threeawn, and less palatable forbs. With continued abuse, short grasses, such as red grama, hairy grama, Texas grama, tumblegrass, and threeawn, invade along with weeds, such as ragweed, broomweed, and curlycup gumweed. Woody invaders include such plants as pricklypear, baccharis, and mesquite.

Clay Loam range site. The Austin, Bolar, Denton, Krum, Lamar, Lewisville, Lott, and Sunev soils in map units AsB, BgB, DeB, KrC, LaD, LeB, LoB, LoD, and SzB are in the Clay Loam range site (fig. 14). In its pristine condition, this is a true tall grass prairie site, which is highly productive. The composition, by weight, is 85 percent grasses, 5 percent woody plants, and 10 percent forbs.

Little bluestem dominates the site, constituting 50 to 60 percent of the total annual yield. Indiangrass, big bluestem, switchgrass, Virginia wildrye, Canada wildrye, and Florida paspalum make up about 20 percent. Sideoats grama, silver bluestem, low panicums, and Texas wintergrass make up about 10 percent. Short grasses make up about 5 percent. Woody plants include hackberry, elm, pecan, and oak. The primary forbs are Maximilian sunflower, Engelmann daisy, penstemon, bundleflower, and numerous other legumes.

As retrogression occurs because of overgrazing, tall grasses, such as bluestems, indiangrass, switchgrass, and Florida paspalum, decrease in abundance and are replaced by sideoats grama, silver bluestem, low panicums, Texas wintergrass, and tall dropseed. If the range condition deteriorates, invader plants, such as threeawn, hairy grama, red lovegrass, Texas grama, buffalograss, tumblegrass, western ragweed, broomweed, and prairie coneflower, and woody plants, such as mesquite, baccharis, yaupon, and hawthorn, dominate and the total production potential is reduced.

Clayey Bottomland range site. The Ovan, Ships, and Tinn soils in map units Ov, Sh, Tn, and To are in the Clayey Bottomland range site. The climax plant community is a tall grass savannah. Oak, elm, hackberry, cottonwood, ash, black willow, some pecan, and other large trees make up about 30 percent of the canopy cover. The canopy is generally heavier along

Figure 14.—Goats grazing on a Clay Loam range site. The soil is Bolar gravelly clay loam, 1 to 3 percent slopes. Raising goats was a significant industry in western McLennan County, but few herds remain today.

streams and drainageways. Cool-season grasses and sedges grow under the canopy, and warm-season grasses and forbs dominate the open areas. The composition, by weight, is 75 percent grasses, 20 percent woody plants, and 5 percent forbs.

Sedges, Virginia wildrye, Canada wildrye, and rustyseed paspalum make up 15 percent of the composition, by weight. Such plants as beaked panicum, switchgrass, indiangrass, vine mesquite, and Florida paspalum make up 55 percent. Buffalograss, longleaf uniola, knotroot bristlegrass, and other grasses make up about 5 percent. The forbs are tickclover, snoutbean, lespedeza, and gayfeather.

This range site is preferred by livestock. Heavy grazing and suppression of fire reduce the abundance of warm-season grasses and forbs and allow brush to form a dense canopy. Shade-tolerant grasses then dominate the understory, and the total amount of usable forage is drastically reduced.

Claypan Prairie range site. The Bremond, Crockett, Mabank, Payne, and Wilson soils in map units BrB, CrB, MaA, MbA, PcB, and WnA are in the Claypan Prairie range site. In climax condition this is a true tall grass prairie site. Oak, elm, and hackberry trees grow along drainageways and in motts. The composition, by weight, is 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

Little bluestem and indiangrass make up 65 percent of the climax plant community. Switchgrass, big bluestem, Virginia wildrye, Canada wildrye, Florida paspalum, sideoats grama, meadow dropseed, Texas wintergrass, and vine mesquite make up 15 percent. Purpletop, brownseed paspalum, longspike tridens, buffalograss, low panicums, fall witchgrass, and sedges make up 5 percent. Live oak, elm, hackberry, bumelia, coralberry, and an occasional post oak make up 5 percent of the total production. Many forbs, such as Maximilian sunflower, Engelmann daisy, halfshrub

sundrop, western indigo, and prairie clover, make up 10 percent of the composition.

Continued overgrazing by cattle decreases the abundance of big bluestem, little bluestem, indiangrass, and switchgrass. Meadow dropseed, silver bluestem, sideoats grama, and Texas wintergrass increase in abundance. Finally, mesquite and pricklypear invade the site, and buffalograss, Texas wintergrass, Texas grama, windmillgrass, and weedy forbs dominate the site.

Claypan Savannah range site. The Axtell soil in map unit AxB is in the Claypan Savannah range site. The climax plant community is a post oak and blackjack oak savannah in which trees shade 15 to 20 percent of the ground. The composition, by weight, is about 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

About 60 percent of the climax vegetation is made up of little bluestem, indiangrass, and brownseed paspalum. The other grasses are switchgrass, Florida paspalum, purpletop, low panicums, low paspalums, silver bluestem, tall dropseed, and Texas wintergrass. Woody plants include post oak, blackjack oak, elm, yaupon, hawthorn, and American beautyberry. Forbs include dayflower, bundleflower, sensitive briar, tickclover, wildbean, and lespedeza.

If retrogression occurs as a result of heavy grazing, fire suppression, or both, little bluestem, indiangrass, and switchgrass are replaced by brownseed paspalum, silver bluestem, arrowfeather threeawn, tall dropseed, purpletop, and low panicums. Woody plants, such as post oak, elm, yaupon, and hackberry, increase in abundance and form a dense canopy that suppresses grass and forb production.

Deep Redland range site. The Crawford soil in map unit CfB is in the Deep Redland range site. The climax vegetation consists of mid and tall grasses. The composition, by weight, is 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

Indiangrass, big bluestem, and little bluestem make up 50 percent of the vegetation. Sideoats grama and Texas wintergrass make up about 20 percent. Other grasses are Texas cupgrass, silver bluestem, buffalograss, Canada wildrye, vine mesquite, Wright threeawn, tall dropseed, white tridens, meadow dropseed, and plains lovegrass. Woody plants include live oak, greenbriar, hackberry, sumac, Texas oak, and bush honeysuckle. Forbs include Maximilian sunflower, bush sunflower, Engelmann daisy, dotted gayfeather, blacksamson, Mexican sagewort, bundleflower, asters, guaras, and mallow.

When retrogression of the range site occurs as a result of heavy use, the tall grasses are first grazed out and are replaced by sideoats grama, Texas wintergrass, silver bluestem, and buffalograss. Further deterioration results in a stand of mostly buffalograss and Texas wintergrass. The main plants when the site is in poor condition are woody species, such as mesquite, ashe juniper, elm, and sumac. The dominant forbs are eryngo, coneflower, and western ragweed.

Deep Sand range site. The Desan soil in map unit DsC is in the Deep Sand range site. The climax vegetation is a post oak and blackjack oak savannah with a 20 to 25 percent canopy. The understory consists of mid and tall grasses. The composition, by weight, is 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

Little bluestem makes up about 50 percent of the composition, and indiangrass makes up about 10 percent. Also evident, but in lesser amounts, are purpletop, switchgrass, and sand lovegrass. Other grasses are low panicums, purple lovegrass, sand dropseed, brownseed paspalum, and splitbeard bluestem. Such woody plants as blackjack oak and post oak make up 10 percent of the composition. Other woody plants include shrubs, such as yaupon, hawthorn, and American beautyberry, which are the understory species. Forbs include legumes, such as lespedeza, tickclover, and partridge pea.

As retrogression takes place, little bluestem, sand lovegrass, indiangrass, and purpletop decrease in abundance and low panicums, low paspalums, purple lovegrass, and woolysheath threeawn increase. Oak and yaupon increase in abundance and form a dense canopy. The decreasing and increasing plants are finally replaced by red lovegrass, tumble lovegrass, crabgrass, red sprangletop, sandbur, brackenfern, pricklypear, and queensdelight. The production of forage species is reduced to nothing.

Eroded Blackland range site. The Ellis, Ferris, and McLennan soils in map units EsE, FeE2, and McE are in the Eroded Blackland range site. The potential plant community is a tall grass prairie. Although the climax vegetation has been destroyed by cultivation and the productive ability of the site has been reduced by erosion, the altered site can grow essentially the same tall grass species as the Blackland range site. A long period of time (40 years or more) is required for secondary plant succession to reestablish itself under natural conditions. The potential plant community, by weight, is 85 percent grasses, 5 percent woody plants, and 10 percent forbs.

Little bluestem, indiangrass, and big bluestem make up 70 percent of the potential plant community, and Virginia wildrye, Canada wildrye, switchgrass, Florida paspalum, sideoats grama, tall dropseed, silver bluestem, Texas wintergrass, and vine mesquite make up 15 percent. Live oak, hackberry, elm, bumelia, and

coralberry make up 5 percent of the composition, and many forbs, such as Maximilian sunflower, Engelmann daisy, and bundleflower, make up 10 percent.

Most of this site is at an intermediate stage of secondary plant succession. Silver bluestem, tall dropseed, Texas wintergrass, sideoats grama, and buffalograss normally dominate the areas in this condition, and they respond as increasers. If heavy use is continued, the site is dominated by buffalograss, Texas wintergrass, or both.

Gravelly range site. The Riesel soil in map unit RgB is in the Gravelly range site. In pristine condition, this site is a post oak and blackjack oak savannah. The overstory of oak and associated species shades about 15 to 20 percent of the ground. The composition, by weight, is 80 percent grasses, 5 percent forbs, and 15 percent woody plants.

The understory is dominated by little bluestem, which makes up about 50 to 65 percent of the total annual yield. Occurring in smaller amounts are indiangrass, beaked panicum, purpletop, brownseed paspalum, and sideoats grama. Palatable cool-season forage plants are scarce on this site. The site has a good variety of forbs, legumes, shrubs, and woody vines.

As retrogression occurs, the tall decreasers are replaced by increasers, such as brownseed paspalum, low panicums, and dropseeds. As further abuse occurs, oak, yaupon, greenbriar, hawthorns, and American beautyberry often form a dense overstory, which severely limits the production of herbaceous plants. If the range condition deteriorates, annual grasses and forbs dominate the site. The invader species, such as eastern redcedar, baccharis, bitter sneezeweed, mesquite, and broomsedge bluestem, limit the productivity of the site.

Loamy Bottomland range site. The Bosque, Frio, Gowen, Weswood, and Yahola soils in map units Bh, Fr, Go, Wd, We, Ya, and Yg are in the Loamy Bottomland range site. The climax plant community is a tall grass savannah in which trees shade 30 percent of the ground. The overstory consists of oaks, pecan, hackberry, elm, cottonwood, and ash species. The understory species are hawthorns, greenbriar, honeysuckle, grapes, and peppervine. Cool-season grasses and sedges dominate the shaded areas, whereas warm-season grasses dominate the open areas. The composition, by weight, is 75 percent grasses, 20 percent woody plants, and 5 percent forbs.

Virginia wildrye, sedges, and Texas wintergrass grow in the shaded and wet areas. They make up 25 percent of the composition. Switchgrass, beaked panicum, indiangrass, big bluestem, little bluestem, eastern gamagrass, vine mesquite, and purpletop grow in the open areas. They make up 35 percent of the plant community. Redtop panicum, gaping panicum, low panicums, uniolas, buffalograss, knotroot bristlegrass, Texas wintergrass, and other grasses make up 10 percent. The forbs are tickclover, lespedeza, snoutbean, partridge pea, and gayfeather.

This range site is preferred by livestock. Overgrazing and fire suppression reduce the abundance of warm-season grasses and forbs and increase the tree and brush canopy. Shade-tolerant grasses and forbs then dominate the herbaceous production, and forage production is drastically reduced.

Low Stony Hill range site. The Eckrant soil in map unit EcB is in the Low Stony Hill range site. The climax plant community on this site is a live oak savannah with a tree canopy of less than 20 percent. Live oak motts are most abundant along watercourses, where elm and hackberry trees also grow. The vegetation is 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

Little bluestem, big bluestem, and indiangrass make up about 55 percent, by weight, of the composition. Sideoats grama, silver bluestem, vine mesquite, Texas wintergrass, Canada wildrye, and Virginia wildrye make up about 25 percent. Forbs include Maximilian sunflower, bush sunflower, Engelmann daisy, gayfeather, bundleflower, sensitivebriar, clover, and western ragweed.

When retrogression occurs, the tall grasses are grazed out and are replaced by mid grasses, such as sideoats grama and Texas wintergrass. With additional grazing pressure, short grasses, forbs, and woody plants invade the site. The invader species are Texas grama, hairy tridens, croton, silverleaf nightshade, broomweed, pricklypear, ashe juniper, and some mesquite.

Sandy range site. The Dutek and Styx soils in map units DuB and SyB are in the Sandy range site. The climax vegetation is an open savannah of post oak and blackjack oak, which shade 20 to 25 percent of the ground. The interspaces are dominated by tall grasses. The composition, by weight, is 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

About 50 percent of the composition is little bluestem, and 10 percent is indiangrass. Switchgrass, beaked panicum, sand lovegrass, purpletop, and brownseed paspalum make up 10 percent. Other grasses are fringeleaf paspalum, purple lovegrass, tall dropseed, splitbeard bluestem, and low panicums. Post oak and blackjack oak make up about 10 percent of the total annual production. The woody plants in the

understory are hawthorn, American beautyberry, greenbriar, yaupon, and berry vines. The forbs are lespedeza, tickclover, sensitive briar, snoutbean, tephrosia, partridge pea, and western ragweed.

With continuous overgrazing and the lack of natural fires, the taller grasses are grazed out or are shaded out by an increasing canopy of woody species. Little bluestem, indiangrass, and switchgrass are replaced by brownseed paspalum, tall dropseed, fall witchgrass, and other increasing species. These species, in turn, are grazed out and are replaced by red lovegrass, yankeeweed, bullnettle, snakecotton, and croton. Other invading plants are broomsedge bluestem, smutgrass, sandbur, pricklypear, queensdelight, beebalm, pricklypoppy, baccharis, and waxmyrtle. Woody species increase in abundance and invade, forming dense thickets.

Sandy Bottomland range site. The Gaddy soil in map unit Ga is in the Sandy Bottomland range site. The climax vegetation on this site is a tall grass savannah with a canopy of as much as 20 percent. Live oak, pecan, elm, cottonwoods, and other large trees dominate the overstory. Little bluestem, indiangrass, and switchgrass make up about 60 percent of the herbaceous plant community. The composition, by weight, is about 75 percent grasses, 20 percent woody plants, and 5 percent forbs.

If retrogression occurs as a result of heavy grazing, the better grasses are replaced by less palatable plants, such as hairy grama, threeawn, knotroot bristlegrass, and red lovegrass. If abuse continues for many years, mesquite, grass bur, bullnettle, willows, and short grasses, such as hairy grama and threeawn, increase significantly in abundance.

Sandy Loam range site. The Bastsil, Chazos, Gholson, and Minwells soils in map units BaA, CaB, GhD, MnB, and MnC2 are in the Sandy Loam range site. The climax plant community is a post oak and blackjack oak savannah with a canopy of 20 to 25 percent. The understory consists of mid and tall grasses. The total composition, by weight, is 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

Little bluestem makes up 50 percent of the composition, and indiangrass makes up about 10 percent. Eastern gamagrass, switchgrass, big bluestem, beaked panicum, and longleaf uniola make up 10 percent of the composition, and numerous other grasses make up another 10 percent. Post oak and blackjack oak make up about 10 percent. The numerous other woody plants include elm, yaupon, greenbriar, American beautyberry, and berry vines. The forbs include Engelmann daisy, gayfeather, sensitive briar, and native legumes.

If the occurrence of wildfires is reduced and overgrazing continues, this range site deteriorates. The woody canopy increases. The tall grasses, such as little bluestem, indiangrass, big bluestem, and eastern gamagrass, decrease in abundance and are replaced by such plants as brownseed paspalum. If overgrazing persists, the site deteriorates to thickets of oak and brush, annual grasses, forbs, and carpetgrass.

Shallow range site. The Aledo and Purves soils in map units AdC, AdE, and PvB are in the Shallow range site. The climax plant community is a prairie of mid and tall grasses interspersed with an abundance of forbs and scattered live oak motts and a few elm and ashe juniper trees along breaks. The composition, by weight, is 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

Little bluestem makes up about 50 percent of the composition, and indiangrass and big bluestem make up about 10 percent. Other grasses are sideoats grama, tall dropseed, slim tridens, silver bluestem, Texas cupgrass, hairy grama, buffalograss, and vine mesquite. Forbs include scurfpea, prairie clover, Maximilian sunflower, Engelmann daisy, catclaw sensitivebriar, heath aster, golden dalea, snoutbean, and dotted gayfeather.

When retrogression occurs as a result of overgrazing, big bluestem, indiangrass, and switchgrass are replaced by little bluestem, sideoats grama, and tall dropseed. Further overgrazing results in an invasion of woody plants, forbs, and the less productive, less palatable grasses, such as tumblegrass, red threeawn, hairy tridens, Texas grama, and Hall panicum. The invader forbs are queensdelight, milkweed, nightshade, and western ragweed. The invader woody species are mesquite, pricklypear, and ashe juniper.

Shallow Clay range site. The Oglesby soil in map unit OgB is in the Shallow Clay range site. The climax vegetation on this site is a mixture of mid and short grasses with a 20 percent canopy of live oak, ashe juniper, and elm. The climax vegetation is about 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

Little bluestem, big bluestem, and indiangrass make up about 65 percent, by weight, of the composition. Sideoats grama, Texas wintergrass, buffalograss, and Texas cupgrass make up about 20 percent. The major forbs are Maximilian sunflower, Engelmann daisy, gayfeather, bundleflower, coneflower, and western ragweed.

If this site is subject to continuous heavy grazing, the tall and mid grasses are grazed out and are replaced by less palatable species, such as threeawn,

hairy grama, hairy tridens, Texas grama, mesquite, pricklypear, and ashe juniper.

Steep Adobe range site. The Brackett and Real soils in map units AdE and ReF are in the Steep Adobe range site. The climax vegetation is mainly a tall grass community with scattered clumps of oak and ashe juniper. The vegetation is about 75 percent grasses, 15 percent woody plants, and 10 percent forbs.

Typically, about 40 percent of the composition is little bluestem, indiangrass, and big bluestem. Mid grasses, such as sideoats grama, tall grama, and hairy grama, make up about 20 percent of the composition. Hairy dropseed, silver bluestem, and rough tridens make up 15 percent. Texas oak, live oak, ashe juniper, ash, and sumac make up about 15 percent. Forbs, such as wild alfalfa, big dalea, white milkwort, trailing ratany, dotted gayfeather, and prairie clover, make up about 10 percent.

If the site is continuously overgrazed, the more palatable bluestems, indiangrass, and switchgrass disappear and mid grasses, such as sideoats grama and Texas wintergrass, dominate the site. With continued overgrazing, the mid grasses also disappear and such grasses as perennial threeawn, hairy tridens, red grama, and Texas grama dominate the site. With the invasion of these grasses, the quality and quantity of the forage are drastically reduced. When the range condition is poor, the vegetation commonly is dominated by an overstory of ashe juniper, Texas oak, shin oak, and sumac.

Recreation

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the

period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

This section was prepared by Matthew R. Judy, biologist, Natural Resources Conservation Service, Temple, Texas.

The abundance of wildlife in McLennan County depends on the kind and amount of available habitat. Habitat is defined as the suitable combination of food, water, and cover necessary to sustain a particular species.

Water is available in most parts of the county, so the kinds and amounts of vegetation commonly determine the type of wildlife in a particular area. The county has four identifiable vegetative areas that provide different kinds of habitat for wildlife. These areas are Crops-Grass Openland, Post Oak Woods and Grasslands, Silver Bluestem-Texas Wintergrass Grasslands, and Oak-Mesquite-Juniper-Elm Woods.

The Crops-Grass Openland is the largest habitat area in the county. It dominates the southern, eastern, and western parts of the county. Most of general soil map units 1, 2, 4, 7, 9, 10, 11, 12, and 13 are in this habitat area. The area consists of fields of cropland and scattered grasslands. It commonly is dissected by wooded drainageways, creeks, and fence rows. Grassed waterways commonly extend into the fields. This habitat area has low or moderate value for wildlife because of a lack of suitable yearlong cover. Mourning dove and bobwhite quail numbers tend to be moderate. They depend largely on the cover and residual grain available after harvest. This area has a low potential for deer, squirrel, waterfowl, and furbearers.

The Post Oak Woods and Grasslands area is mostly along the east side of the Brazos River. It includes most of general soil map units 6, 15, and 16. It consists of motts of dense woody cover interspersed with grasslands and some cropland. The motts are of various sizes. Few white-tailed deer inhabit the area, mainly because of a scarcity of year-round food supplies and because of land settlement patterns. If properly managed, this area could support moderate numbers of quail. The population of fox squirrel, cottontail rabbit, and furbearers is moderate, and the population of mourning dove generally is low. This habitat area and parts of the Crops-Grass Openland area currently have an abundance of coyote, which keep the population of rodents, rabbits, and other animals low.

The Silver Bluestem-Texas Wintergrass Grasslands area is on upland ridges between the major river drainage areas in the northwestern part of the county. It is mainly in areas of general soil map unit 3 but also includes the higher parts of units 4 and 5. The area typically consists of open prairie grasslands with a few scattered small trees. Few white-tailed deer inhabit the area, mainly because of the proximity to the more densely wooded breaks and drainageways. The habitat for cottontail rabbit and mourning dove is fair where management produces a variety of grasses and hard-seed native forbs. The habitat for fox squirrel is poor because of a scarcity of trees. The population of bobwhite quail typically is low. With proper management, it could be increased. The habitat for waterfowl is poor because most of the soils are shallow and constructing ponds is difficult. The population of furbearers usually is low, but it fluctuates with the demand for furs.

The Oak-Mesquite-Juniper-Elm Woods habitat area borders the Brazos, North Bosque, Middle Bosque, and South Bosque Rivers and is on breaks to the smaller creeks in the central and western parts of the county. It is mainly in areas of general soil map units 8, 11, and 14 but is also in the parts of units 4 and 5 near the major drainageways. The highest concentration of white-tailed deer in the county is in this habitat area. Studies indicate that the population of deer and turkeys is increasing. The population of fox squirrel, cottontail rabbit, bobwhite quail, waterfowl, and furbearers is moderate.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of

fair indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, kleingrass, clover, and vetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are little bluestem, sideoats grama, goldenrod, Maximilian sunflower, and partridge pea.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are elbowbush, greenbriar, sumac, and coral berry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are wild millet, rushes, sedges, and cattails.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, mourning dove, field sparrow, cottontail, coyote, and fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, herons, shore birds, nutria, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, meadowlark, robin, and cedar waxwing.

Urban Development

This section was prepared by Robert E. Cervenka, Department of Planning, Waco, Texas.

The major urbanized areas of McLennan County are the city of Waco and the surrounding cities of Woodway, Hewitt, Robinson, Beverly Hills, Bellmead, Lacy-Lakeview, and Northcrest. These cities account for 78 percent of the population in the county. They lie within Waco's Five Mile Extraterritorial Jurisdiction (ETJ). Within this jurisdiction area, communities must structure development according to Waco standards.

Prudent land use planning and development must take into account such interrelated factors as topography, the construction and maintenance of streets, foundation design, installation of water and sewer lines, septic systems, and the design of storm-water drainage and erosion-control systems *(14)*.

Topography

McLennan County is characterized by flat to gently rolling topography. Elevation ranges from 350 feet above mean sea level in an area along the Brazos River in the southern part of the county to 924 feet above mean sea level in the northwest corner of the county.

The Balcones Fault Zone is in the Waco area. This fault zone is not considered inactive. Along the eastern

edge of Lake Waco, a steep, westward-facing hillslope, locally known as the Bosque escarpment, presents locally severe problems for development. The escarpment is capped by Austin Chalk and underlain by the South Bosque Shale geological formation. Slumping of the shale is common on natural and altered slopes. Failure of the shale slopes can remove support from beneath the chalk, resulting in failure and slumping of the Austin Chalk. In past years the slopes along the escarpment bordering the Lake Waco Reservoir have failed readily, causing severe damage to property and natural features.

Waco currently enforces an escarpment zone ordinance concerning building construction and other development along the eastern shoreline of the Lake Waco Reservoir. The purpose of the ordinance is to preserve the stability and value of public and private property, minimize the cost of public improvements, ensure retention of the natural character of the escarpment, and ensure proper development by observance of detailed restrictions. The ordinance specifies that particular care must be exercised in order to maintain a natural slope angle along the escarpment if present and future structures are to be protected.

Water

The municipal water for Waco is obtained from the Lake Waco Reservoir, which was enlarged in 1965. The dual purpose of the reservoir is water conservation and flood control. The normal conservation pool has a capacity of 104,100 acre-feet of storage at an elevation of 455 feet above mean sea level. The reservoir covers 7,270 acres of land with a shoreline of 60 miles. The flood-control pool has a capacity of 553,300 acre-feet at an elevation of 500 feet above mean sea level.

Along the Bosque River and the upper reaches of the Brazos River, development has been limited. Much of the flood plain in these areas has been retained for public use and remains in its natural state. The raising of the Brazos River to create Lake Brazos has played an important role in urban waterfront development and downtown development.

Street Construction

While problems in street construction generally do not inhibit development in the urban and suburban areas of McLennan County, deep clays with a high shrink-swell potential and low support strength can make street construction costly and maintenance frequent *(5)*. In areas where expansive soil problems may occur, a heavier flexible base, a greater depth of lime-stabilized subgrade, and moisture barriers can extend the life of the street *(26)*.

Foundation Construction

The structure and mineralogy of the soil are major factors in proper foundation design. Problems arise in the deeper clayey soils. These expansive soils create vertical and horizontal pressures, which can cause foundation damage. Foundations should be engineered according to soil properties, including the depth to bedrock, the depth to a water table, and natural drainage conditions *(5)*.

Soils on flood plains commonly are poor building sites. The problems affecting building site development in these areas include a high shrink-swell potential, a low bearing capacity, a high water table, poor drainage, and a hazard of flooding. Construction is permitted on the flood plains only with the authorization of county and city officials *(26)*.

Water and Sewer Installation

The installation of water and sewer lines throughout the Waco area and the suburban areas of McLennan County typically is limited by corrosive soil properties, which affect cast iron and steel pipe. Concrete, PVC, and clay pipe generally are not affected by soil corrosion *(15)*.

The major problem related to water and sewer lines is the continual shifting and movement of deep clayey soil, which may fracture the lines between sections laterally or at the joints. Seepage can then occur, causing leakage of sewer effluent. Varying amounts of water are released over short periods of time. During periods of higher rainfall, infiltration into the lines can overload sewer treatment facilities. The effluent from sewer lines may be discharged to area streams or migrate into local water tables.

Septic Systems

In the suburban areas of McLennan County, where sewer systems have not yet been extended, the use of septic system drainage for residential, commercial, and industrial land uses is prevalent. If the soil is not properly tested and the system not adequately designed and installed, problems that can affect public health arise.

Waco-McLennan County Public Health District statistics for the past 12 years, using percolation tests in the determination of septic system sizes, have revealed that several areas of Waco’s ETJ are experiencing trouble with septic system drainage *(10)*. These areas are on flat to gently rolling topography in the northern, western, and southern sections. They are within flood-prone areas of

small streams. The impermeable soils in these areas prevent or hinder septic system operation, and effluent seepage may endanger the water quality of the streams.

Storm-Water Drainage and Erosion Control

Continuing urbanization in McLennan County is affected by the infiltration characteristics related to soil type, type of vegetative cover, and percent of impervious surface and surface retention. The amount of runoff can be as much as 1.2 times more than the amount under natural conditions.

Unless adequate provisions have been made for increased runoff, channel erosion and flooding will occur in most areas. Downstream sites may be adversely affected by the increased runoff. Alternatives that retard this flow should be considered.

The problem of channel erosion in the city of Waco and in the surrounding cities has been solved by the installation of concrete channel lining along the streams and creeks that flow through the area. This lining protects the channel banks from erosion during periods of high water and often aids in the conveyance of floodwater. Care should be taken to prevent excessive erosion downstream of such channelized areas.

Erosion control during construction is needed to protect local streams from sedimentation. Sediment can adversely affect water quality in streams. Also, the hazard of local flooding can be increased if channel conveyance is altered through the deposition and stabilization of in-stream sediment wedges.

Gardening and Landscaping

Homeowners need an understanding of the soils on their property in order to be successful in growing plants. Plants may be needed for erosion control and for esthetic purposes and food production.

Most of the soils in McLennan county are alkaline and calcareous. Some of the soils on high terraces along the Brazos River are slightly acid or neutral. The reaction (pH) for each soil series is given in table 14. Garden and landscape plants can be grown on most of the soils in the county. Most of the soils require additions of nitrogen, and some require phosphorus and potassium for maximum growth. A soil test should be used to determine specific needs. Whether grown on natural soil or on man-made soil, all plants require careful maintenance, especially during the period of establishment. Good management includes applications of fertilizer, mulching, watering, and control of weeds, insects, and disease. Native species should be planted on the landscape when possible because they require less water and maintenance.

In areas of clayey soils, raised beds are often constructed to improve drainage for shrubs and flowers. Native soil mixed with organic matter should be used in these beds. Lawns and flower beds should be watered only as needed. The frequency of watering might be once per week in summer and less often in spring and fall. When the plants are watered, at least 1 inch of water should be applied.

Organic matter is the most important soil amendment. The most common sources of organic matter are compost, leaves, grass clippings, rotted sawdust or hay, and manure. Incorporating organic matter into the soil increases the available water capacity, the rate of water infiltration, biological activity, and the availability of nutrients.

Lawns should be mowed on a regular basis, and all clippings should be left on the lawn as fine organic matter. During hot summer months, mowing turf at the highest possible mower setting lowers the soil temperature and conserves water.

Growing garden and landscape plants can be a pleasant and rewarding hobby, provided that the homeowner understands the physical and chemical requirements of the soil. Information about growing specific plants can be obtained from the Cooperative Extension Service or the Natural Resources Conservation Service.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the “Soil Properties” section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil

properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 10 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated

slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable

material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A

restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 16.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading “Soil Series and Their Morphology.”

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, “gravelly.” Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 16.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data *(20)* for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^1/_3$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling

of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 14, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep and very deep well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep to very deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 15 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. “More than 6.0” indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A *cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 16 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section “Soil Series and Their

Morphology." The soil samples were tested by the Texas Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); Specific gravity—T 100 (AASHTO), D 854 (ASTM); and Shrinkage—T 92 (AASHTO), D 427 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(18, 21)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustalf (*Ust*, meaning burnt or dry, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustalfs (*Hapl*, meaning minimal horizonation, plus *ustalf*, the suborder of the Alfisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Arenic* identifies one subgroup of the great group. An example is Arenic Haplustalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is loamy, siliceous, thermic Arenic Haplustalfs.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the “Soil Survey Manual” *(22)*. Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” *(18)* and in “Keys to Soil Taxonomy” *(21)*. Unless otherwise indicated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section “Detailed Soil Map Units.”

Aledo Series

The Aledo series consists of very shallow or shallow, gently sloping to moderately steep, well drained, loamy soils on uplands (fig. 15). These soils formed in material weathered from interbedded, hard limestone and marl of Lower Cretaceous age. Slopes range from 2 to 20 percent. Soils in the Aledo series are loamy-skeletal, carbonatic, thermic Lithic Calciustolls.

Typical pedon of Aledo gravelly clay loam, 2 to 5 percent slopes; from the intersection of Texas Highway

317 and Texas Highway 6 in Valley Mills, 4.4 miles east on Texas Highway 6 to Delmar Ranch, 0.6 mile north on a gravel road, and 50 feet east in an area of rangeland:

A—0 to 4 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; many fine roots and pores; about 20 percent, by volume, limestone gravel and about 5 percent, by volume, limestone cobbles; calcium carbonate equivalent of 45 percent; violently effervescent; moderately alkaline; gradual irregular boundary.

Ak—4 to 12 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, friable; common fine roots and pores; about 50 percent, by volume, limestone pebbles and cobbles that are coated with calcium carbonate on the lower side; calcium carbonate equivalent of 65 percent; violently effervescent; moderately alkaline; abrupt wavy boundary.

R—12 to 28 inches; fractured, indurated limestone bedrock interbedded with chalky marl.

The solum ranges from 9 to 20 inches in thickness. The content of limestone fragments ranges from 5 to 35 percent in the A horizon and from 40 to 60 percent in the Ak horizon. The fragments are mostly less than 6 inches across the long axis. The control section has 35 to 50 percent limestone fragments. The calcium carbonate equivalent is 40 to 70 percent throughout the solum.

The A horizon is gravelly clay loam or clay loam. The Ak horizon is very gravelly clay loam or loam. The colors of both horizons are very dark grayish brown, dark grayish brown, or dark brown.

The R layer is coarsely fractured limestone. It is interbedded with layers of weakly cemented limestone and marly and loamy material.

Austin Series

The Austin series consists of moderately deep, gently sloping, well drained, clayey soils on uplands. These calcareous soils formed in clayey marl or material weathered from chalky limestone of Upper Cretaceous age. Slopes range from 0 to 3 percent. Soils in the Austin series are fine-silty, carbonatic, thermic Udorthentic Haplustolls.

Typical pedon of Austin silty clay, 1 to 3 percent slopes; from the intersection of Interstate Highway 35 and Robinson Road 2 miles northeast of Lorena, 0.4 mile northeast on Robinson Road, 150 feet southeast of Robinson Road, and 200 feet south of a barn:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine granular and subangular blocky structure; hard, firm but crumbly, sticky and plastic; many fine roots; many fine and very fine pores; many wormcasts; common fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

A—6 to 15 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate very fine subangular blocky and granular structure; hard, firm but crumbly, sticky and plastic; many fine roots; many fine and very fine pores; many wormcasts; common fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bw1—15 to 27 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; hard, firm but crumbly, sticky and plastic; few fine roots; many fine pores; many light yellowish brown (2.5YR 6/4) wormcasts; common fine concretions of calcium carbonate; few fine fragments of chalk; violently effervescent; moderately alkaline; clear smooth boundary.

Bw2—27 to 30 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common wormcasts; about 30 percent platy fragments of chalk less than 3 inches across the long axis; violently effervescent; moderately alkaline; clear irregular boundary.

Cr—30 to 36 inches; white (10YR 8/2) and very pale brown (10YR 8/4), platy chalk that is less hard than 3 on the Mohs scale; few thin tongues of brown silty clay in crevices between chalk plates.

The depth to chalky marl or soft limestone ranges from 20 to 40 inches. About 5 to 15 percent of the surface area is covered with limestone gravel in some pedons.

The A horizon commonly is 12 to 18 inches thick. It is very dark grayish brown, grayish brown, dark grayish brown, or dark brown.

The B horizon is 10 to 25 inches thick. It is pale brown, brown, yellowish brown, grayish brown, or light brownish gray.

The Cr horizon is white, platy chalk, interbedded chalk and marl, or soft limestone bedrock.

Axtell Series

The Axtell series consists of very deep, gently sloping, moderately well drained, loamy soils on Pleistocene-age stream terraces along the Brazos River. These soils formed in alkaline, clayey and loamy alluvial sediments. Slopes range from 1 to 3 percent. Soils in the Axtell series are fine, montmorillonitic, thermic Udertic Paleustalfs.

Typical pedon of Axtell fine sandy loam, 1 to 3 percent slopes; from the intersection of U.S. Highway 84 and North Loop 340 in Bellmead, 4.1 miles east on U.S. Highway 84 to its intersection with Texas Highway 31, about 2.8 miles northeast on Texas Highway 31, and 80 feet southeast of road, in a wooded pasture:

A—0 to 4 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; massive; very hard, friable; many fine and medium roots; common fine pores; few siliceous pebbles; slightly acid; clear smooth boundary.

E—4 to 7 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; weak fine subangular blocky structure; very hard, friable; common fine and medium roots; few siliceous pebbles; strongly acid; abrupt wavy boundary.

Bt1—7 to 15 inches; reddish yellow (5YR 6/6) clay, yellowish red (5YR 5/6) moist; few fine distinct gray (5YR 5/1) mottles; moderate medium prismatic structure parting to moderate medium and coarse subangular blocky; extremely hard, very firm; common medium roots; common fine pores; distinct clay films on the surface of peds; few siliceous pebbles; very strongly acid; gradual wavy boundary.

Bt2—15 to 22 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; few medium distinct yellowish red (5YR 4/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; few fine and medium roots; few slickensides and pressure faces; distinct clay films on the surface of peds; few siliceous pebbles; moderately acid; gradual wavy boundary.

Bt3—22 to 36 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; many coarse prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; extremely hard, very firm; few slickensides and pressure faces; thin clay films on the surface of peds; few siliceous pebbles; neutral; gradual wavy boundary.

Btk1—36 to 51 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; common faint yellow (10YR 7/8) mottles; moderate medium subangular blocky structure; extremely hard, very firm; few slickensides and pressure faces; few clay films on the surface of peds; common concretions of calcium carbonate; few fine and coarse siliceous pebbles; neutral; gradual wavy boundary.

Btk2—51 to 80 inches; light gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) moist; moderate medium subangular blocky structure; extremely hard, very firm; few clay films on the surface of peds; few fine black concretions; common concretions of calcium carbonate; few fine and coarse siliceous pebbles; neutral.

The solum ranges from 60 to more than 80 inches in thickness.

The A horizon is 4 to 10 inches thick. It is grayish brown, dark grayish brown, brown, or pale brown. The content of quartz and chert pebbles ranges from 1 to 15 percent.

The E horizon, if it occurs, is light yellowish brown, pale brown, or very pale brown, strongly acid to slightly acid fine sandy loam or loam. The content of siliceous gravel ranges from 1 to 15 percent.

The Bt horizon is grayish brown, gray, brown, yellowish red, or yellowish brown. Some pedons have yellowish red, gray, or yellowish brown mottles. The texture is clay or clay loam. Reaction ranges from very strongly acid to strongly acid in the Bt1 horizon and from strongly acid to neutral in the Bt2 and Bt3 horizons.

The Btk horizon is gray, grayish brown, light brownish gray, or light gray. It is clay loam or clay. Reaction ranges from neutral to moderately alkaline.

In some pedons a C horizon is below a depth of 60 inches. It is gray or brownish gray clay loam or clay. Reaction ranges from neutral to moderately alkaline.

Bastsil Series

The Bastsil series consists of very deep, nearly level or gently sloping, well drained soils on Pleistocene-age terraces along the North Bosque and Brazos Rivers. These soils formed in loamy alluvial sediments. Slopes range from 0 to 3 percent. Soils in the Bastsil series are fine-loamy, siliceous, thermic Udic Paleustalfs.

Typical pedon of Bastsil fine sandy loam, 0 to 2 percent slopes; from the intersection of Farm Road 933 and Farm Road 1858 in Gholson, 1.4 miles north

on Farm Road 1858 to Gholson School, 2.0 miles southwest on a county road, and 100 feet north in a cropland field:

Ap—0 to 9 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; hard, friable; few fine and medium roots; few fine and medium pores; few siliceous pebbles; neutral; gradual smooth boundary.

Bt1—9 to 27 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable; few fine and medium roots; few fine pores; few clay films on the surface of peds; few siliceous pebbles; neutral; gradual smooth boundary.

Bt2—27 to 62 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable; few fine and medium roots; few fine and medium pores; few clay films on the surface of peds; few siliceous pebbles; neutral; gradual smooth boundary.

BC—62 to 80 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; few thin strata of fine sandy loam; massive; hard, friable; few soft accumulations of calcium carbonate; few siliceous pebbles; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. The content of clay in the particle-size control section ranges from 20 to 35 percent. The content of siliceous pebbles ranges from 0 to 10 percent, and most pedons have beds of gravel and sand below a depth of 80 inches.

The A horizon is brown, reddish brown, or dark brown. Reaction ranges from moderately acid to neutral.

The Bt horizon is red, reddish yellow, yellowish red, light reddish brown, or reddish brown. Some pedons have a few yellowish or reddish mottles. The texture is sandy clay loam or clay loam. Reaction ranges from moderately acid to slightly alkaline.

The BC horizon is light brown, brown, yellowish red, or reddish yellow. It is mostly sandy clay loam but has strata and pockets of fine sandy loam or loamy fine sand and in some pedons has strata of gravelly loamy fine sand or sand and gravel. Reaction ranges from moderately acid to moderately alkaline.

Bolar Series

The Bolar series consists of moderately deep, gently sloping, well drained, loamy soils on uplands (fig. 16). These soils formed in material weathered from interbedded limestone and marl of Cretaceous age. Slopes range from 1 to 3 percent. Soils in the Bolar series are fine-loamy, carbonatic, thermic Udic Calciustolls.

Typical pedon of Bolar gravelly clay loam, 1 to 3 percent slopes; from the intersection of Texas Highway 317 and Farm Road 185 in Crawford, 8.2 miles west on Farm Road 185 and 50 feet south in a plowed field:

Ap—0 to 4 inches; dark brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky and moderate fine granular structure; hard, friable, sticky and plastic; many fine and few medium roots; common fine and medium pores; few concretions of calcium carbonate; about 20 percent, by volume, limestone fragments, mostly less than 3 inches across the long axis; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—4 to 12 inches; dark brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, friable; 20 percent, by volume, limestone fragments, mostly less than 1/2 inch but ranging to 5 inches across the long axis; few fine concretions of calcium carbonate; 40 percent calcium carbonate equivalent; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—12 to 20 inches; brown (7.5YR 5/4) gravelly clay loam, dark brown (7/5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm; slightly sticky and slightly plastic; common fine strongly cemented concretions and few threads and films of calcium carbonate; about 15 percent, by volume, limestone fragments; 45 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk2—20 to 28 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common very fine and fine roots; common concretions and masses of calcium carbonate; few limestone fragments; 65 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; abrupt wavy boundary.

R—28 to 40 inches; fractured limestone bedrock interbedded with soft marly earth.

The solum ranges from 20 to 40 inches in thickness. The content of silicate clay in the control section ranges from 20 to 35 percent. The calcium carbonate equivalent in the control section ranges from 40 to 70 percent. The content of limestone

fragments as much as 8 inches across ranges from 3 to 25 percent, by volume, in the solum.

The A horizon is dark brown, very dark brown, grayish brown, or very dark grayish brown.

The Bk horizon is dark yellowish brown, yellowish brown, brown, pale brown, or light yellowish brown. It is loam, clay loam, silty clay loam, or the gravelly counterparts of those textures.

The R layer is indurated limestone bedrock that is interbedded with marly soil material or chalky limestone at vertical intervals of 4 to 20 inches. Cracks or fractures are spaced about 6 to 30 inches apart.

Bosque Series

The Bosque series consists of very deep, nearly level, well drained, loamy soils on flood plains along streams draining the Grand Prairie. These soils formed in loamy, calcareous alluvium of Holocene age. Slopes are 0 to 1 percent. Soils in the Bosque series are fine-loamy, mixed, thermic Cumulic Haplustolls.

Typical pedon of Bosque clay loam, occasionally flooded; from the west city limits of China Spring on Farm Road 1637, about 1.0 mile west on Farm Road 1637, about 3.0 miles south on a county road, and 200 feet west in an area of pasture:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine and few medium roots; common wormcasts; common fine pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—6 to 22 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine and few medium roots; common fine and many very fine pores; common wormcasts; few fine concretions of calcium carbonate; few shell fragments; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bw1—22 to 63 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine pores; few wormcasts; common films and threads of calcium carbonate; violently effervescent; moderately alkaline; gradual smooth boundary.

Bw2—63 to 80 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; very hard, friable, slightly sticky and slightly plastic; few coarse roots; many films and threads of calcium carbonate; violently effervescent; moderately alkaline.

The depth to sand, gravel, or limestone ranges from 5 to about 30 feet. The content of clay ranges from 20 to 35 percent. The calcium carbonate equivalent ranges from 15 to 40 percent. Some pedons have light colored, discontinuous loamy or sandy strata less than 3 inches thick. Some pedons have limestone and siliceous pebbles, which make up less than 15 percent of the volume. Reaction is slightly alkaline or moderately alkaline throughout the profile.

The A horizon is brown, very dark grayish brown, dark grayish brown, dark brown, or grayish brown.

The Bw horizon is brown, grayish brown, pale brown, light brownish gray, light yellowish brown, or yellowish brown. It is loam or clay loam. Some pedons have a buried A horizon below a depth of 40 inches.

Some pedons are underlain by a stratified, brownish C horizon of fine sandy loam, loam, or clay loam.

Brackett Series

The Brackett series consists of very deep, strongly sloping or moderately steep, well drained, loamy soils on uplands. These soils are underlain by thin-bedded limestone and marly loam of Lower Cretaceous age. Slopes range from 5 to 20 percent. Soils in the Brackett series are fine-loamy, carbonatic, thermic Udic Ustochrepts.

Typical pedon of Brackett gravelly clay loam, in an area of Aledo-Brackett complex, 5 to 20 percent slopes; from the intersection of Farm Road 1637 and Bend of the Bosque Road, 0.9 mile west of China Spring, 1.2 miles southwest on Bend of the Bosque Road, 1.2 miles northwest and 0.7 mile west on a gravel road, in a road cut 25 feet east of the road:

A—0 to 10 inches; grayish brown (10YR 5/2) gravelly clay loam, dark grayish brown (10YR 4/2) moist; moderate very fine granular and subangular blocky structure; slightly hard, friable; common fine and few medium roots; common shell fragments; about 40 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; clear smooth boundary.

Bw—10 to 16 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate very fine granular and subangular

blocky structure; hard, friable; common fine and few medium roots; few shell fragments; about 50 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; clear smooth boundary.

CB—16 to 23 inches; yellow (10YR 8/6) clay loam; weak coarse subangular blocky structure; hard, friable; few fine roots; about 15 percent, by volume, thin, platy, weakly cemented limestone fragments less than 3 inches across; few very fine concretions of calcium carbonate; about 50 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; clear smooth boundary.

C—23 to 60 inches; yellow (10YR 8/6) clay loam with alternating layers of gravelly clay loam having about 25 percent limestone and claystone fragments less than 3 inches across; hard, friable; few fine roots; about 50 percent calcium carbonate equivalent; violently effervescent; moderately alkaline.

The solum ranges from 15 to 30 inches in thickness. The texture of the soils is loam, clay loam, gravelly loam, or gravelly clay loam. The content of carbonates in the control section ranges from 40 to 80 percent. The content of weakly cemented limestone and shell fragments is a few to as much as 30 percent, by volume. The fragments are platy and are mostly less than 2 inches thick.

The A horizon is grayish brown, brown, yellowish brown, light yellowish brown, pale brown, or light brownish gray. It is 4 to 12 inches thick.

The B horizon is grayish brown, pale brown, yellowish brown, light yellowish brown, very pale brown, or brown. It is 15 to 25 inches thick in most pedons.

The C horizon is very pale brown, light yellowish brown, yellow, light gray, white, pale yellow, or brownish yellow. It is loam, silt loam, or clay loam with thin layers of platy limestone, large flat limestone fragments, or shell fragments.

Branyon Series

The Branyon series consists of very deep, nearly level or gently sloping, moderately well drained, clayey soils on Pleistocene-age stream terraces. These soils formed in alkaline, clayey and loamy alluvial sediments. Slopes range from 0 to 3 percent. Soils in the Branyon series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Branyon clay, 0 to 1 percent slopes; from the intersection of U.S. Highway 84 and Texas Highway 317 in McGregor, 0.3 mile north on Texas Highway 317, about 0.4 mile east on a county road, 130 yards south of the road and adjacent to Harris Creek channel, in a microdepression:

Ap—0 to 4 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine granular structure; extremely hard, very firm, very sticky and plastic; few fine roots and pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bss1—4 to 36 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots and pores; common prominent slickensides; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bss2—36 to 56 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic; many prominent slickensides; common concretions of calcium carbonate as much as $^{1}/_{8}$ inch in diameter; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bkss—56 to 80 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and plastic; common prominent slickensides; few vertical streaks, as much as $^{1}/_{8}$ inch wide, of dark gray soil from the horizon above; common masses of calcium carbonate; few siliceous pebbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk—80 to 90 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and plastic; common concretions and masses of calcium carbonate; common limestone fragments as much as 2 inches in diameter; violently effervescent; moderately alkaline.

The solum ranges from 60 to more than 100 inches in thickness. Cycles of microdepressions and microknolls are repeated every 10 to 24 feet. When the soils are dry, cracks 1 to 3 inches wide extend from the surface to a depth of more than 20 inches. The content of clay ranges from 45 to 60 percent. Chroma of more than 1.5 is at a depth of 25 to 80 inches in 85 percent or more of each pedon. Some pedons are noncalcareous in the microdepressions.

The Ap or A horizon is dark gray, very dark gray, or black. It is neutral to moderately alkaline. It generally is

slightly effervescent to strongly effervescent, but some pedons are noneffervescent in the surface layer.

The Bss and Bkss horizons are dark gray, very dark gray, black, or gray. They are clay or silty clay. The content of siliceous or limestone fragments ranges from 0 to 15 percent, by volume.

The Bk horizon is pale brown, dark grayish brown, brown, light brownish gray, grayish brown, gray, light gray, or yellowish brown. Some pedons have vertical streaks, which are filled cracks of darker colored material. The texture is clay or silty clay. The content of siliceous or limestone fragments ranges from 0 to 15 percent, by volume.

Some pedons are underlain by gravelly clay, silty clay, clay loam, gravel, or limestone at a depth of more than 60 inches.

Bremond Series

The Bremond series consists of very deep, nearly level or gently sloping, moderately well drained, loamy soils on Pleistocene-age stream terraces. These soils formed in clayey alluvial deposits along the Brazos River. Slopes range from 0 to 2 percent. Soils in the Bremond series are fine, montmorillonitic, thermic Udertic Paleustalfs.

Typical pedon of Bremond loam, 0 to 2 percent slopes; from the intersection of Farm Road 1858 and Rogers Hill Road 1.8 miles east of Gholson, 2.8 miles north on Rogers Hill Road to its intersection with a county road, 0.2 mile east on the county road, and 50 feet north in a cropland field:

Ap—0 to 5 inches; light yellowish brown (10YR 6/4) loam, brown (10YR 4/3) moist; massive; very hard, friable; few fine and medium roots; few siliceous pebbles; slightly acid; abrupt smooth boundary.

Bt1—5 to 12 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; common medium distinct dark red (2.5YR 3/6) mottles; moderate fine and medium angular blocky structure; extremely hard, very firm; few fine roots; distinct clay films on the surface of peds; cracks 1/2 inch wide in the upper part; moderately acid; diffuse wavy boundary.

Bt2—12 to 24 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; common medium distinct red (2.5Y 5/4) mottles; moderate medium and coarse angular blocky structure; extremely hard, very firm; few slickensides and pressure faces; few manganese concretions; moderately acid; gradual wavy boundary.

Btk1—24 to 37 inches; dark yellowish brown (10YR 4/4) clay, dark yellowish brown (10YR 3/4) moist; few faint dark grayish brown (10YR 4/2) mottles; moderate medium and coarse subangular blocky structure; extremely hard, very firm; few slickensides and pressure faces; few clay films; common concretions of calcium carbonate and 15 to 20 percent, by volume, soft accumulations of calcium carbonate; moderately alkaline; gradual smooth boundary.

Btk2—37 to 55 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; extremely hard, very firm; common slickensides and pressure faces; few thin clay films on the surface of peds; few calcium sulfate crystals; few fine black concretions; few concretions of calcium carbonate and 20 to 30 percent, by volume, soft accumulations of calcium carbonate; few siliceous pebbles; moderately alkaline;gradual smooth boundary.

Btk3—55 to 80 inches; brownish yellow (10YR 6/6) clay, yellowish brown (10YR 5/6) moist; few faint dark grayish brown mottles; moderate medium angular blocky structure; extremely hard, very firm; few fine black concretions; many fine concretions of calcium carbonate; strongly effervescent; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness.

The thickness of the A horizon averages less than 10 inches but ranges from 4 to 15 inches. This horizon is light yellowish brown, yellowish brown, dark grayish brown, grayish brown, pale brown, light brown, brown, or dark brown. Reaction ranges from moderately acid to neutral.

The Bt horizon is brown, dark yellowish brown, pale brown, brownish yellow, light yellowish brown, or yellowish brown. Red or grayish mottles are common in the upper part of the horizon and yellow, brown, or olive mottles are common in the lower part. The texture is clay, clay loam, or sandy clay. Reaction ranges from moderately acid in the upper part of the horizon to moderately alkaline in the lower part. Accumulations of calcium carbonate are common in the lower part of the horizon, and some pedons have calcium sulfate crystals.

Some pedons have a C horizon below a depth of 60 inches.

Burleson Series

The Burleson series consists of very deep, nearly level, moderately well drained, clayey soils on stream terraces of Pleistocene age. These soils formed in clayey alluvium. Slopes are 0 to 1 percent. Soils in the

Burleson series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Burleson clay, 0 to 1 percent slopes; from the intersection of Farm Road 3434 and Farm Road 1637 northwest of Waco, 1.5 miles north on Farm Road 3434, and 50 feet west in a cropland field at the center of a microdepression:

Ap—0 to 7 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; a thin surface crust of light gray (10YR 5/1) silty clay; weak fine angular blocky structure; extremely hard, very firm, very sticky and plastic; common fine roots; few fine dark concretions; few fine siliceous pebbles; slightly acid; diffuse wavy boundary.

A1—7 to 24 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine and medium roots; common pressure faces; few fine dark concretions; few fine siliceous pebbles; slightly acid; diffuse wavy boundary.

Bss1—24 to 40 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; common pressure faces; common prominent slickensides; few fine iron-manganese concretions; slightly acid; diffuse wavy boundary.

Bss2—40 to 60 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; few medium faint yellowish brown (10YR 5/2) mottles; few streaks of very dark gray (10YR 3/1) material from the horizon above; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; many prominent slickensides; few fine strongly cemented concretions of calcium carbonate; slightly alkaline; diffuse wavy boundary.

Bkss—60 to 80 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; many prominent slickensides; common concretions of calcium carbonate; few films and threads of calcium carbonate; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. Native areas have gilgai microrelief consisting of microknolls and microdepressions. The microknolls are as much as 10 inches higher than the microdepressions, and the center of the microknolls is 5 to 15 feet from the center of the microdepressions. When the soils are dry, cracks 1 to 3 inches wide extend from the surface to a depth of more than 40 inches. The depth to slickensides is 20 to more than 60 inches.

The A horizon is black, gray, dark gray, or very dark gray clay. It is slightly acid to moderately alkaline and is noncalcareous in the matrix.

The Bss horizon is black, gray, dark gray, or very dark gray. It is clay or silty clay. It has few to many slickensides. The horizon is slightly alkaline or moderately alkaline and is calcareous in some pedons.

The Bk horizon is grayish brown, dark grayish brown, gray, light brownish gray, or light gray. Some pedons have mottles in shades of red, gray, or yellow. The texture is clay, silty clay, or clay loam. Reaction is slightly alkaline or moderately alkaline. The horizon has few or common concretions and masses of calcium carbonate. Some pedons have reddish, loamy or clayey material below a depth of 60 inches.

Chazos Series

The Chazos series consists of very deep, gently sloping, moderately well drained, sandy soils on Pleistocene-age stream terraces along the Brazos River. Slopes range from 1 to 3 percent. Soils in the Chazos series are fine, montmorillonitic, thermic Udic Paleustalfs.

Typical pedon of Chazos loamy fine sand, 1 to 3 percent slopes; from the intersection of Farm Road 3148 and U.S. Highway 77 in Robinson, 0.9 mile south on U.S. Highway 77 to its intersection with a paved road, 0.75 mile southeast on the paved road, 0.75 mile south and 0.9 mile east, 250 feet south of road in a wooded residential area:

A—0 to 8 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; many very fine roots; few fine pores; few fine and medium rounded siliceous pebbles; neutral; clear smooth boundary.

E—8 to 15 inches; light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; few fine pores; few fine and medium rounded siliceous pebbles; neutral; abrupt wavy boundary.

Bt—15 to 27 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; common prominent strong brown (7.5YR 5/6), few distinct red (2.5YR 4/6), and few faint light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; very hard, very firm; few fine roots; few fine dark concretions; few clay films; few siliceous and limestone pebbles as much as $^{1}/_{4}$

inch in size; moderately acid; diffuse wavy boundary.

Btk1—27 to 40 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; many prominent strong brown (7.5YR 5/6), common yellowish brown (10YR 5/4), and common faint gray (10YR 5/1) mottles; moderate medium angular blocky structure; very hard, very firm; few fine roots; few fine dark concretions; few clay films; common concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

Btk2—40 to 55 inches; gray (10YR 5/1) sandy clay, dark gray (10YR 4/1) moist; common prominent yellowish brown (10YR 5/4) mottles; moderate medium angular blocky structure; very hard, very firm; common concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

BC—55 to 80 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; common prominent yellow (10YR 7/6) mottles; massive; very hard, very firm; bedding planes in about 15 percent of the horizon; common masses of calcium carbonate; strongly effervescent; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness. The content of rounded siliceous pebbles ranges from 0 to about 15 percent, by volume, throughout the solum.

The A horizon is 6 to 18 inches thick. It is light brown, light yellowish brown, brown, grayish brown, or dark grayish brown loamy fine sand. Reaction ranges from moderately acid to neutral. The E horizon has color value that is 1 to 3 units higher than that in the A horizon. Cultivation usually mixes the A and E horizons.

The Bt horizon is extremely variable in color and distinctiveness of mottling within the pedon. Red, yellow, and brown are the dominant colors. Mottles are in shades of red, gray, or yellow. The horizon is clay, sandy clay, clay loam, or the gravelly counterparts of those textures. Reaction ranges from moderately acid to neutral.

The Btk horizon generally has colors in shades of gray or brown. Some pedons have red or yellowish mottles. The texture is dominantly clay or sandy clay, but some pedons have layers of sandy clay loam. Reaction is moderately alkaline. The horizon has few or common concretions or masses of calcium carbonate.

The BC horizon is sandy clay loam, clay loam, or clay and in some pedons is stratified below a depth of 60 inches. Reaction ranges from slightly acid to moderately alkaline. The horizon has few or no concretions or masses of calcium carbonate.

Crawford Series

The Crawford series consists of moderately deep, gently sloping, well drained, clayey soils on smooth uplands. These soils formed in material weathered from limestone that is interbedded with calcareous clays and is of Lower Cretaceous age. Slopes range from 0 to 2 percent. Soils in the Crawford series are fine, montmorillonitic, thermic Leptic Udic Haplusterts.

Typical pedon of Crawford clay, 0 to 2 percent slopes; from the intersection of U.S. Highway 84 and Farm Road 317 in McGregor, 3.3 miles west on U.S. Highway 84, about 2.5 miles north on Farm Road 938, about 1 mile west on a county road, and 150 feet south in a plowed field behind an abandoned homestead:

Ap—0 to 5 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; weak fine angular blocky structure; very hard, firm; common fine roots; few siliceous pebbles as much as $^{1}/_{8}$ inch in diameter; slightly alkaline; gradual smooth boundary.

A—5 to 11 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; fine medium angular blocky structure; very hard, firm, very sticky and plastic; common pressure faces; few siliceous pebbles as much as $^{1}/_{8}$ inch in diameter; slightly alkaline; gradual smooth boundary.

Bss1—11 to 27 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and plastic; common distinct slickensides; many pressure faces; few concretions of calcium carbonate; common siliceous pebbles and limestone fragments; neutral; clear smooth boundary.

Bss2—27 to 34 inches; reddish brown (5YR 4/4) gravelly silty clay, dark reddish brown (5YR 3/4) moist; moderate medium angular blocky structure; very hard, very firm; common prominent slickensides; common quartz pebbles and limestone fragments 4 to 6 inches in diameter; strongly effervescent; moderately alkaline; gradual irregular boundary.

Bss3—34 to 38 inches; yellowish red (5YR 5/6) gravelly silty clay, yellowish red (5YR 4/6) moist; moderate medium angular blocky structure; very hard, very firm; common prominent slickensides; many limestone fragments 4 to 6 inches in

diameter; violently effervescent; moderately alkaline; abrupt irregular boundary.

R—38 to 48 inches; fractured, hard limestone with dark reddish brown clay in cracks and crevices.

The solum is 20 to 40 inches deep over hard limestone bedrock. The content of limestone fragments and stones ranges from a few to 5 percent of the soil matrix. When the soils are dry, cracks 0.4 inch to 2.0 inches wide extend from the surface to a depth of 20 inches or more. The content of clay ranges from 40 to 60 percent. Most pedons are effervescent, but the microlows are noneffervescent in some pedons.

The Ap and A horizons are dark reddish gray, dark reddish brown, reddish brown, brown, or dark brown. They are clay or silty clay. Reaction ranges from slightly acid to moderately alkaline.

The Bss horizon is brown, dark brown, very dark brown, reddish gray, dark reddish gray, reddish brown, or dark reddish brown. It is silty clay, clay, gravelly silty clay, or gravelly clay. Some pedons have a layer with 15 to 35 percent limestone fragments below a depth of 20 inches. The horizon is slightly acid to moderately alkaline and is mainly effervescent. Some pedons have accumulations of calcium carbonate above the fractured limestone bedrock.

The R layer is indurated limestone interbedded with clayey marl.

Crockett Series

The Crockett series consists of gently sloping, moderately well drained, loamy soils on uplands. These soils are deep to weathered shale. They formed in clays weathered from alkaline shale of Upper Cretaceous age. Slopes range from 3 to 5 percent. Soils in the Crockett series are fine, montmorillonitic, thermic Udertic Paleustalfs.

Typical pedon of Crockett loam, 3 to 5 percent slopes; from the intersection of Farm Road 2491 and Farm Road 2957 north of Trading House Creek Reservoir, 1 mile east on Farm Road 2957 and 200 feet north of road, in an area of rangeland.

A—0 to 9 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; very hard, friable; few fine and medium roots; moderately acid; abrupt wavy boundary.

Bt1—9 to 24 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; common medium distinct yellowish brown (10YR 5/6) and reddish brown (5YR 5/4) mottles; moderate fine and medium angular blocky structure; extremely hard, very firm; few fine roots; distinct clay films on the surface of peds; cracks 1/2 inch wide in the upper part; moderately acid; diffuse wavy boundary.

Bt2—24 to 36 inches; brown (10YR 4/3) clay, very dark grayish brown (10YR 3/2) moist; common medium distinct yellowish red (5YR 4/6) mottles; moderate medium and coarse angular blocky structure; extremely hard, very firm; few pressure faces; few iron-manganese concretions; slightly acid; gradual wavy boundary.

BCtk—36 to 55 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; few faint yellowish mottles; moderate medium and coarse angular blocky structure; extremely hard, very firm; common concretions and few soft accumulations of calcium carbonate; moderately alkaline; gradual smooth boundary.

Ck—55 to 80 inches; light yellowish brown (2.5Y 6/4) clay with about 40 percent weakly consolidated shale; massive or rock structure; extremely hard, very firm; common concretions of calcium carbonate and few calcium sulfate crystals; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness.

The thickness of the A horizon averages less than 10 inches but ranges from 4 to 15 inches. This horizon is light brown, pale brown, brown, grayish brown, light brownish gray, or dark brown. Reaction ranges from moderately acid to neutral.

The Bt horizon is extremely variable in color and contrast of mottling within the pedon. It is prominently mottled in shades of brown, yellow, red, or olive with matrix colors of reddish brown, dark yellowish brown, or brown. Reddish mottles are mostly in the upper part of the horizon, and yellow, brown, and olive mottles are typically in the lower part. The texture is clay or sandy clay. Reaction ranges from moderately acid to moderately alkaline.

The BCtk horizon generally has colors in shades of brown, olive, or gray. It is clay or clay loam. In some pedons it has weathered shale fragments. The horizon has few to many concretions and masses of calcium carbonate. It is moderately alkaline and calcareous.

The C horizon has colors mostly in shades of brown, olive, or gray. It generally is shale, clayey siltstone, or clay. The horizon is moderately alkaline and calcareous. Most pedons have concretions and masses of calcium carbonate.

Denton Series

The Denton series consists of deep, gently sloping, well drained, clayey soils on uplands. These soils formed in material weathered from indurated limestone

and interbedded marl of Lower Cretaceous age. Slopes range from 1 to 3 percent. Soils in the Denton series are fine-silty, carbonatic, thermic Udic Calciustolls.

Typical pedon of Denton silty clay, 1 to 3 percent slopes; from the intersection of Texas Highway 317 and Farm Road 185 in Crawford, 2.7 miles west on Farm Road 185 and north 0.7 mile on a county road, in a cultivated field 100 yards west of the county road:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, sticky and plastic; few fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

A—5 to 14 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak fine granular and moderate fine subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; few wormcasts; common small pressure faces; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bw—14 to 22 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; common small pressure faces; few fine dark concretions; few limestone fragments; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk—22 to 36 inches; very pale brown (10YR 7/4) silty clay loam, light yellowish brown (10YR 6/4) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine dark concretions; common fine and medium concretions and masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

2C—36 to 52 inches; brownish yellow (10YR 6/6) gravelly silty clay loam; massive; about 20 percent, by volume, limestone fragments 1 to 6 inches across, forming a discontinuous line in the upper part of the horizon; about 20 percent coarse masses and thin discontinuous strata of calcium carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

2R—52 to 60 inches; indurated, slightly weathered limestone bedrock interbedded with marl.

The solum ranges from 24 to 40 inches in thickness, and the depth to limestone bedrock ranges from 40 to 60 inches. The depth to films, threads, or masses of calcium carbonate is 12 to 36 inches. The content of silicate clay in the control section ranges from 25 to 35 percent. The calcium carbonate equivalent is 40 to 65 percent.

The thickness of the A horizon is commonly less than 20 inches but ranges from 8 to 36 inches. This horizon is brown, dark brown, very dark grayish brown, or dark grayish brown. The total clay content ranges from 35 to 55 percent.

The Bw horizon, if it occurs, is reddish brown, dark brown, strong brown, or yellowish brown. It is silty clay or silty clay loam. Reaction is moderately alkaline, and most pedons have a few concretions of calcium carbonate.

The Bk horizon is brown, strong brown, reddish yellow, light yellowish brown, brownish yellow, or very pale brown. It is silty clay loam, loam, or silt loam. The content of pebble- and cobble-sized limestone fragments ranges from 0 to about 15 percent, by volume. The horizon has 5 to 20 percent masses of calcium carbonate.

The 2C horizon, if it occurs, has colors mainly in shades of brown or yellow. It is marly soil material, mainly of silty clay loam or silt loam texture. The content of limestone pebbles or cobbles ranges from a few to about 35 percent, by volume. The limestone fragments typically occur in a discontinuous lag line in the Bk or 2C horizon. Large masses and discontinuous strata of calcium carbonate make up about 5 to 35 percent of the volume.

The 2R layer is indurated limestone bedrock that is interbedded with marly soil material or chalky limestone at vertical intervals of 4 to 20 inches. Cracks or fractures are spaced about 6 to 30 inches apart. The fractures are less than $^1/_4$ inch to about $1^1/_2$ inches wide.

Desan Series

The Desan series consists of very deep, gently sloping, somewhat excessively drained, sandy soils on stream terraces. These soils formed in sandy and loamy Pleistocene-age sediments along the Brazos River. Slopes range from 1 to 5 percent. Soils in the Desan series are loamy, siliceous, thermic Grossarenic Paleustalfs.

Typical pedon of Desan loamy fine sand, 1 to 5 percent slopes; from the intersection of Farm Road 933 and Farm Road 1858 in Gholson, 1.6 miles north on Farm Road 1858, about 1.0 mile west, 0.2 mile north on a private road, and 150 feet northeast in a wooded pasture:

A—0 to 7 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; single grained;

loose, very friable; common fine and very fine and few medium roots; neutral; abrupt smooth boundary.

E—7 to 65 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 4/4) moist; single grained; loose, very friable; few fine and medium roots; few siliceous pebbles as much as 15 millimeters in size; neutral; clear wavy boundary.

Bt—65 to 80 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate medium subangular blocky structure; hard, firm; few fine and medium roots; few clay films on the surface of peds; moderately acid.

The solum ranges from 65 to more than 80 inches in thickness. The combined thickness of the A and E horizons is 40 to 80 inches.

The A horizon is 6 to 8 inches thick. It is reddish brown, pale brown, light brown, light reddish brown, brown, or dark brown. Reaction ranges from strongly acid to neutral.

The E horizon is light reddish brown, pink, reddish yellow, light brown, pale brown, or yellowish red. It is loamy fine sand or fine sand. Reaction ranges from strongly acid to neutral.

The Bt horizon is reddish yellow, reddish brown, light reddish brown, red, light red, or yellowish red. It is sandy clay loam or fine sandy loam. Reaction ranges from strongly acid to slightly acid.

Some pedons have a C horizon, which is reddish or yellowish, stratified loamy fine sand or loamy sand and may have gravelly strata.

Dutek Series

The Dutek series consists of very deep, gently sloping, well drained, sandy soils on stream terraces. These soils formed in sandy and loamy sediments on Pleistocene-age terraces along the Brazos River. Slopes range from 1 to 3 percent. Soils in the Dutek series are loamy, siliceous, thermic Arenic Haplustalfs.

Typical pedon of Dutek loamy fine sand, 1 to 3 percent slopes; from the intersection of Farm Road 933 and Farm Road 1858 in Gholson, 1.2 miles west and 55 feet north in a cropland field:

Ap—0 to 8 inches; brown (7/5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; single grained; soft, loose; common fine and medium roots; few siliceous pebbles; slightly acid; clear smooth boundary.

E—8 to 30 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 5/6) moist; single grained; soft, loose; few medium roots; slightly acid; clear wavy boundary.

Bt1—30 to 48 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; very hard, friable; few clay films on the surface of peds; moderately acid; gradual smooth boundary.

Bt2—48 to 60 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; very hard, friable; few clay films on the surface of peds; strongly acid; gradual wavy boundary.

C—60 to 80 inches; reddish yellow (7.5YR 6/6) loamy fine sand, yellowish red (7.5YR 5/6) moist; slightly hard, very friable; strongly acid.

The solum ranges from 60 to more than 80 inches in thickness. The combined thickness of the A and E horizons is 20 to 40 inches.

The A horizon is brown, strong brown, light brown, or reddish yellow. Reaction ranges from moderately acid to neutral.

The E horizon is reddish yellow, light reddish brown, pink, pale brown, light yellowish brown, or very pale brown. Reaction ranges from moderately acid to neutral.

The B horizon is yellowish red, reddish brown, light reddish brown, or reddish yellow. It is fine sandy loam or sandy clay loam. Reaction ranges from very strongly acid to slightly acid.

The C horizon is yellowish red, reddish yellow, strong brown, reddish brown, or light reddish brown. It is loamy fine sand or fine sandy loam. Some pedons are underlain by sand and gravel.

Eckrant Series

The Eckrant series consists of very shallow or shallow, gently sloping, well drained, clayey soils on uplands. These soils formed in thick beds of massive limestone of Lower Cretaceous age. Slopes range from 1 to 3 percent. Soils in the Eckrant series are clayey-skeletal, montmorillonitic, thermic Lithic Haplustolls.

Typical pedon of Eckrant cobbly silty clay, 1 to 3 percent soples; from the intersection of Farm Road 185 and Prairie Chapel Road in Crawford, 1.5 miles northwest on Prairie Chapel Road and 50 feet east in an area of rangeland:

A1—0 to 4 inches; dark brown (7.5YR 4/2) cobbly silty clay, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky and fine granular structure; very hard, firm, sticky and plastic; common fine and medium roots; few fine pores; about 10 percent limestone pebbles and 20 percent cobbles; slightly alkaline; clear irregular boundary.

A2—4 to 15 inches; dark brown (7.5YR 4/2) very cobbly silty clay, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; very hard, firm; few fine roots; 40 percent, by volume, limestone cobbles; moderately alkaline; abrupt smooth boundary.

R—15 to 40 inches; indurated limestone with a hardness of 4 or more on the Mohs scale; in the upper part, fractures, 12 to 30 inches apart, filled with soil material; few fractures in the lower part.

The thickness of the solum and the depth to limestone bedrock range from 4 to 20 inches. The content of clay ranges from 40 to 55 percent. The content of pebbles, cobbles, and stones ranges from 35 to 60 percent. It increases with increasing depth. The soil matrix ranges from noneffervescent to strongly effervescent. Reaction is slightly alkaline or moderately alkaline.

The A horizon is very dark brown, very dark gray, very dark grayish brown, or dark brown. Secondary calcium carbonate coats some of the limestone fragments. The texture is cobbly silty clay, very cobbly silty clay, or cobbly clay.

The R layer is limestone bedrock that generally cannot be excavated with a backhoe machine. The bedrock generally is hardest (harder than 3 on the Mohs scale) in the upper few feet. In some pedons the bedrock is interbedded with softer material below a depth of 4 or 5 feet.

Eddy Series

The Eddy series consists of shallow or very shallow, gently sloping to strongly sloping, well drained, loamy soils on uplands. These soils formed in clays weathered from chalky limestone of Upper Cretaceous age. Slopes range from 3 to 15 percent. Soils in the Eddy series are loamy-skeletal, carbonatic, thermic, shallow Typic Ustorthents.

Typical pedon of Eddy gravelly clay loam, 3 to 15 percent slopes; from the intersection of Farm Road 107 and Interstate Highway 35 in Eddy, 3.0 miles west on Farm Road 107, in a road cut 25 feet north of Farm Road 107:

A1—0 to 4 inches; brown (7.5YR 4/2) gravelly clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, firm; many fine roots; about 30 percent, by volume, fragments of chalk, mostly $^1/_4$ to $^1/_2$ inch thick and 3 to 4 inches long; few limestone flags as much as 8 inches in diameter on the surface; violently effervescent; moderately alkaline; abrupt wavy boundary.

A2—4 to 8 inches; brown (7.5YR 4/2) very gravelly clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, firm; many fine roots; about 50 percent, by volume, platy fragments of chalk, mostly 3 to 4 inches long and $^1/_4$ inch to $2^1/_2$ inches thick, with some fragments ranging to 12 inches long; violently effervescent; moderately alkaline; abrupt wavy boundary.

Cr—8 to 20 inches; white (10YR 8/2), chalky limestone with a hardness of 2 on the Mohs scale; interbedded with chalky marl.

The thickness of the solum and the depth to chalky limestone range from 3 to 14 inches. The content of weakly cemented to strongly cemented, chalky limestone fragments ranges from 30 to 60 percent, by volume. The fragments are mostly $^1/_8$ inch to 3 inches long, but some are as long as 10 inches. The calcium carbonate equivalent is 40 to 80 percent.

The A horizon is brown, pale brown, grayish brown, dark grayish brown, or dark brown. It is clay loam, gravelly clay loam, or very gravelly clay loam. The content of rock fragments increases with increasing depth. Reaction is moderately alkaline, and effervescence is strong or violent.

The chalky limestone in the Cr horizon ranges in hardness from about 1 to slightly less than 3 on the Mohs scale. In some pedons the hardness increases as depth increases and is more than 3 on the Mohs scale. Some pedons are interbedded with chalky marl.

Ellis Series

The Ellis series consists of strongly sloping or moderately steep, well drained, clayey soils on uplands. These soils are moderately deep to weathered shale. They formed in material weathered from weakly consolidated, platy shale of Upper Cretaceous age. Slopes are convex and range from 8 to 20 percent. Soils in the Ellis series are fine, montmorillonitic, thermic Udertic Ustochrepts.

Typical pedon of Ellis clay, 8 to 20 percent slopes; from the intersection of Farm Road 1858 and Farm Road 933 in Gholson, 1.9 miles east on Farm Road 1858 to Rogers Hill Road, 0.5 mile north on Rogers Hill Road, and 250 feet east in an area of pasture:

A—0 to 4 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; extremely hard, very firm, sticky and plastic; neutral; gradual smooth boundary.

Bw—4 to 14 inches; pale yellow (2.5Y 7/4) clay, light yellowish brown (2.5Y 6/4) moist; moderate medium subangular blocky structure; extremely

hard, very firm, sticky and plastic; few fine concretions of calcium carbonate; few slickensides; few dark concretions; neutral; gradual smooth boundary.

BC—14 to 28 inches; very pale brown (10YR 7/4) clay, very pale brown (10YR 7/3) moist; few medium distinct brownish yellow (10YR 6/6) mottles; moderate medium subangular and angular blocky structure; extremely hard, very firm, sticky and plastic; few fine concretions of calcium carbonate; few slickensides; slightly alkaline; gradual smooth boundary.

C1—28 to 34 inches; distinctly and coarsely mottled light olive gray (5Y 6/2) and yellow (10YR 7/8) shale with clay texture; massive; extremely hard, very firm, sticky and plastic; slightly alkaline; clear irregular boundary.

C2—34 to 60 inches; dark gray (N 4/0), platy shale with clay texture; common masses of yellowish material; few gypsum crystals; slightly alkaline.

The content of clay ranges from 40 to 60 percent. The soils are dominantly noneffervescent but are strongly effervescent in the lower part of the B horizon.

The A horizon is grayish brown, brown, light brownish gray, or dark grayish brown.

The Bw horizon is pale yellow, light olive brown, light brownish gray, grayish brown, or light yellowish brown.

The BC horizon is very pale brown, light gray, gray, or dark gray. Mottles in shades of brown, gray, or olive increase in number with increasing depth. Some pedons have a Bk horizon and accumulations of calcium carbonate and calcium sulfate.

The C horizon is gray or dark gray, platy shale with clay texture. Reaction ranges from neutral to moderately alkaline. Some pedons have concretions of calcium carbonate and gypsum crystals between the interbedded shale layers.

Fairlie Series

The Fairlie series consists of deep, gently sloping, well drained, clayey soils on uplands (fig. 17). These soils formed in material weathered from chalk or interbedded marl and chalk of Upper Cretaceous age. Slopes range from 1 to 3 percent. Soils in the Fairlie series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Fairlie clay, 1 to 3 percent slopes; from the intersection of Farm Road 1695 and Farm Road 2063 in Hewitt, 1.8 miles south on Farm Road 1695, and 100 feet west in an area of cropland:

Ap—0 to 5 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak fine granular and angular blocky structure; extremely hard, very firm; many very fine roots; many very fine pores; slightly effervescent; slightly alkaline; gradual smooth boundary.

A—5 to 14 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak fine angular blocky structure; extremely hard, very firm; many very fine roots; many very fine pores; few slickensides in the lower part; slightly effervescent; slightly alkaline; gradual wavy boundary.

Bss1—14 to 32 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine angular blocky structure; very hard, firm; few fine roots; few fine dark concretions as much as 2 millimeters in diameter; few fine concretions of calcium carbonate as much as 5 millimeters in diameter; common prominent slickensides; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bss2—32 to 36 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium angular blocky structure; very hard, firm; common medium concretions of calcium carbonate; common prominent slickensides; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkss—36 to 42 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium angular blocky structure; very hard, firm, sticky and plastic; many masses of calcium carbonate; common prominent slickensides; violently effervescent; moderately alkaline; abrupt wavy boundary.

Cr—42 to 60 inches; white (2.5Y 8/2), platy chalk interbedded with chalky marl; hardness of less than 3 on the Mohs scale.

The thickness of the solum and the depth to chalk bedrock range from 40 to 60 inches. In undisturbed areas gilgai microrelief consists of knolls 4 to 8 inches higher than depressions. The distance between the center of the knoll and the center of the depression is 5 to 12 feet. When the soils are dry, cracks 1 to 2 inches wide extend from the surface to a depth of 24 inches or more. The soils have few or common slickensides.

The A horizon is black or very dark gray. Reaction is slightly alkaline or moderately alkaline.

The Bss and Bkss horizons are very dark gray, dark gray, grayish brown, gray, dark grayish brown, or very dark brown. Some pedons have mottles in shades of brown, yellow, gray, or olive. Some pedons have weakly cemented dark concretions. The texture is clay, silty clay, or silty clay loam. Reaction is moderately

Figure 15.—Profile of Aledo gravelly clay loam, 2 to 5 percent slopes. This shallow, gravelly soil has a very low available water capacity. It is used mainly for native rangeland.

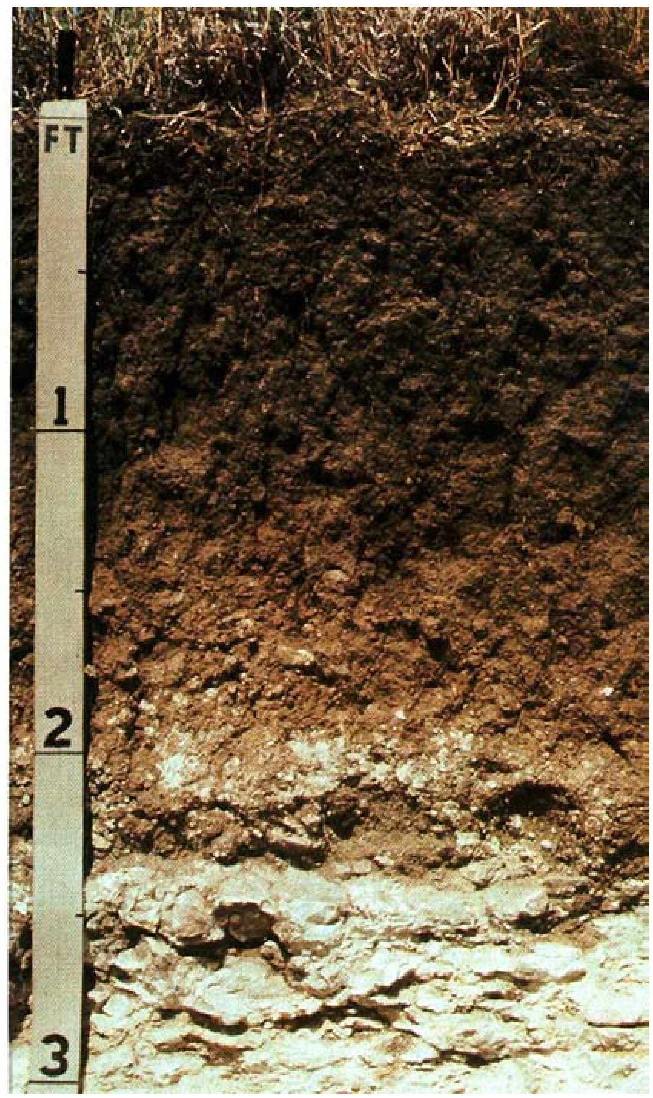

Figure 16.—Profile of Bolar gravelly clay loam, 1 to 3 percent slopes. This carbonatic soil is 28 inches deep over hard, fractured limestone bedrock.

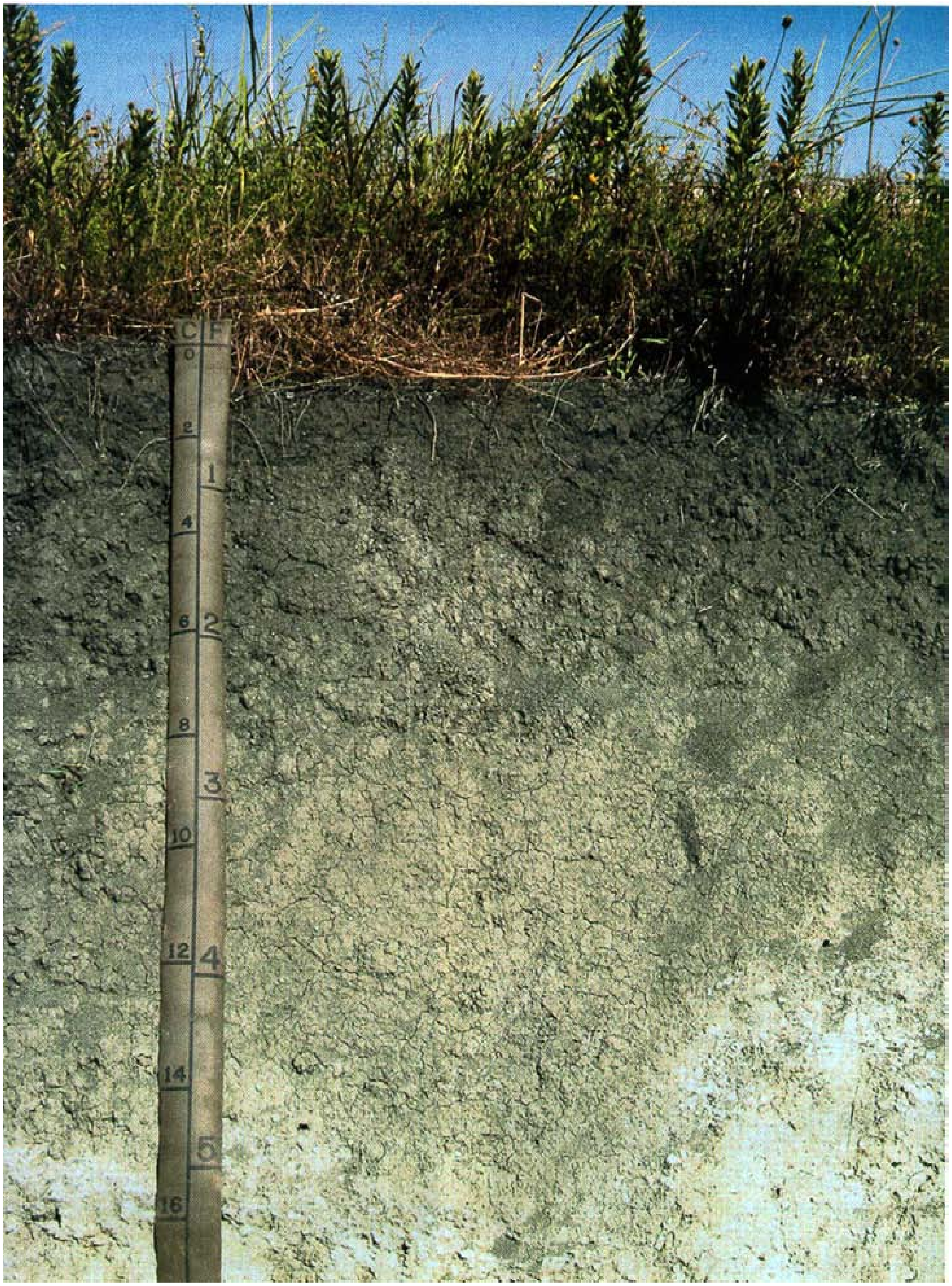

Figure 17.—Profile of Fairlie clay, 1 to 3 percent slopes. Thickness of the dark colored surface layer in this Vertisol is about 6 inches in the microhigh and 30 inches in the microlow only a few feet away.

Figure 18.—Profile of Heiden clay, 1 to 3 percent slopes. This deep, clayey soil cracks when dry. It has a very high shrink-swell potential.

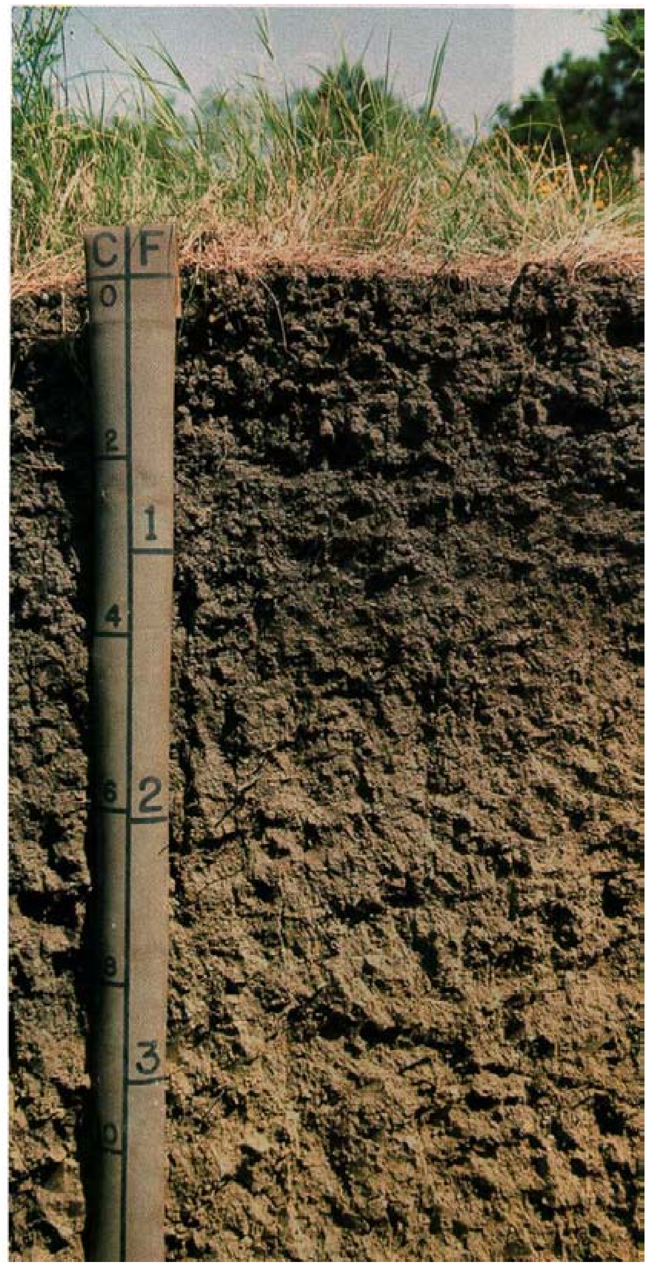

Figure 19.—Profile of Krum silty clay, 2 to 5 percent slopes. The depth to lighter colored subsoil containing calcium carbonate is about 15 inches.

Figure 20.—Profile of Lewisville silty clay, 1 to 3 percent slopes. This deep, moderately permeable soil has a dark granular silty clay surface layer that is easily cultivated.

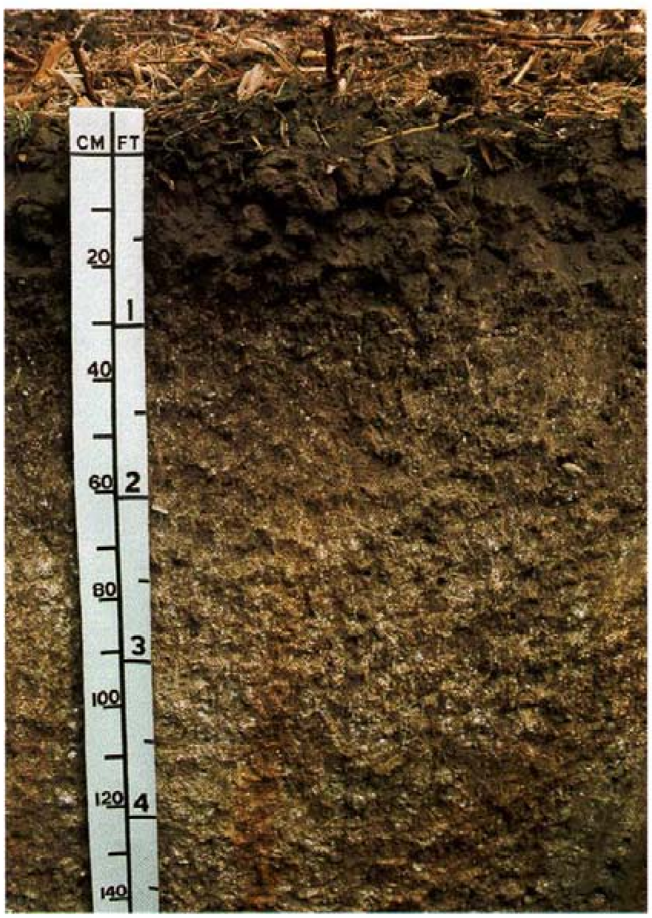

Figure 21.—Profile of Lott silty clay, 1 to 5 percent slopes. The dark surface layer is underlain by lighter colored silty clay subsoil containing many calcium carbonate concretions.

Figure 22.—Profile of Minwells fine sandy loam, 1 to 3 percent slopes. The fine sandy loam surface layer is underlain by slightly acid, reddish brown clay subsoil beginning at a depth of 10 inches.

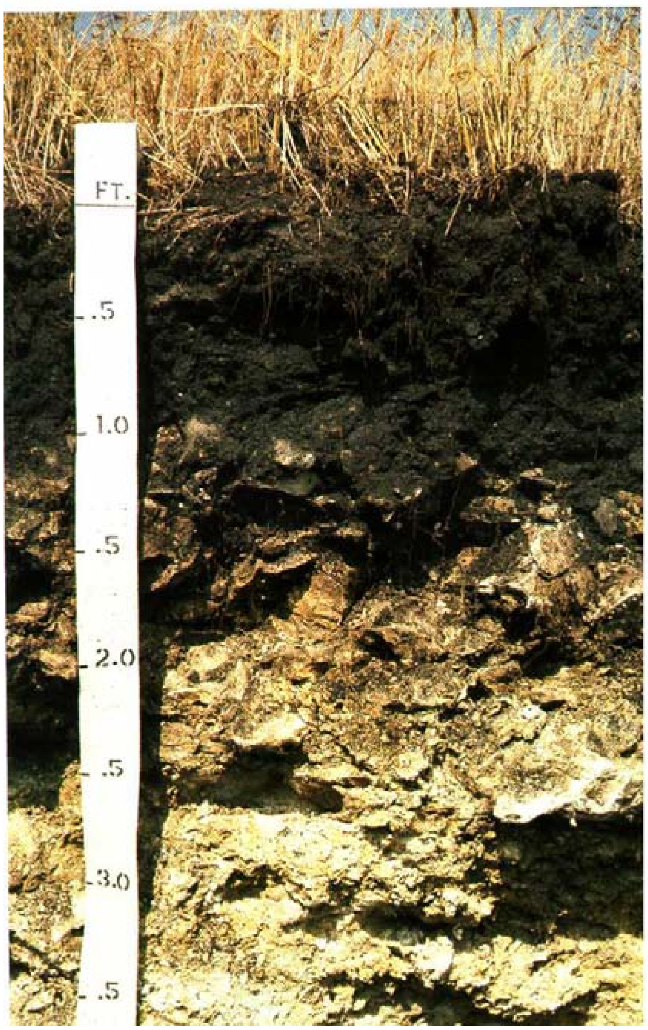

Figure 23.—Profile of Purves clay, 1 to 3 percent slopes. The dark clay surface layer is underlain by limestone bedrock at a depth of 12 inches.

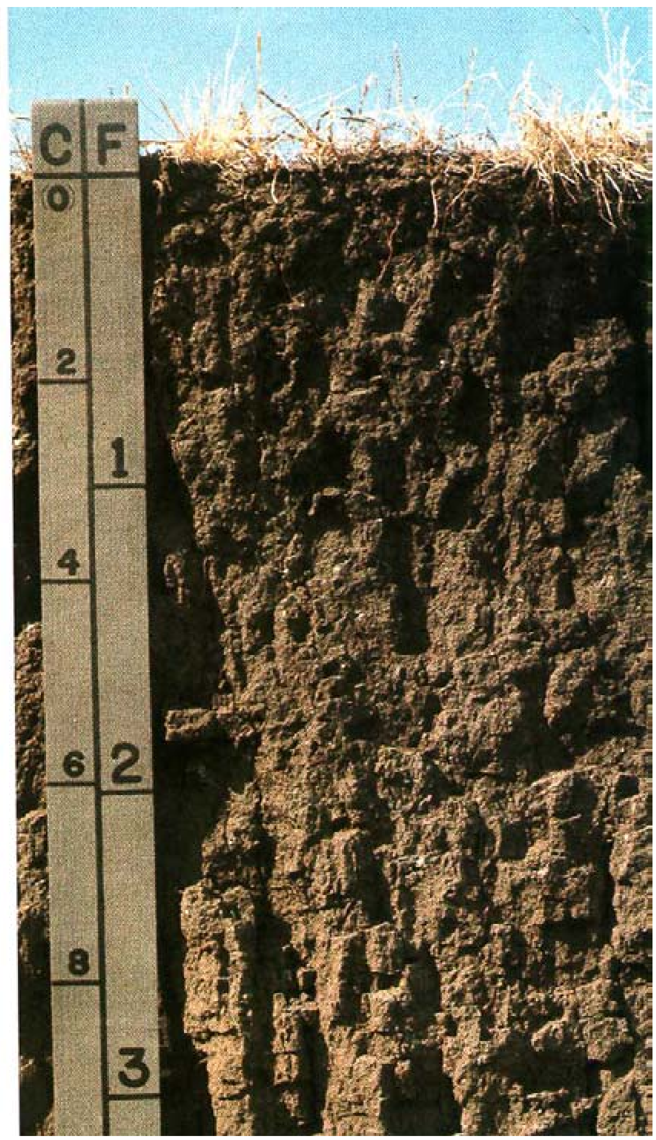

Figure 24.—Profile of Sanger clay, 1 to 3 percent slopes. This very deep, clayey soil has a dark surface layer that is underlain by angular blocky subsoil that contains more calcium carbonate than the surface layer.

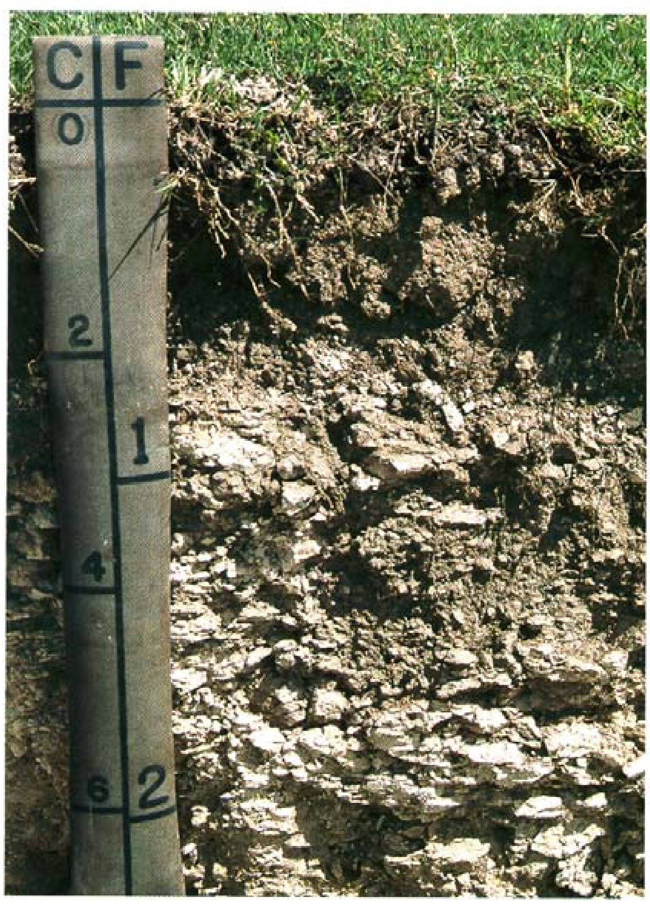

Figure 25.—Profile of Stephen silty clay. This shallow soil is underlain by fractured chalky bedrock at a depth of 10 inches.

Figure 26.—Profile of Sunev clay loam, 1 to 3 percent slopes. This very deep, loamy soil contains many films, threads, and masses of calcium carbonate in the subsoil.

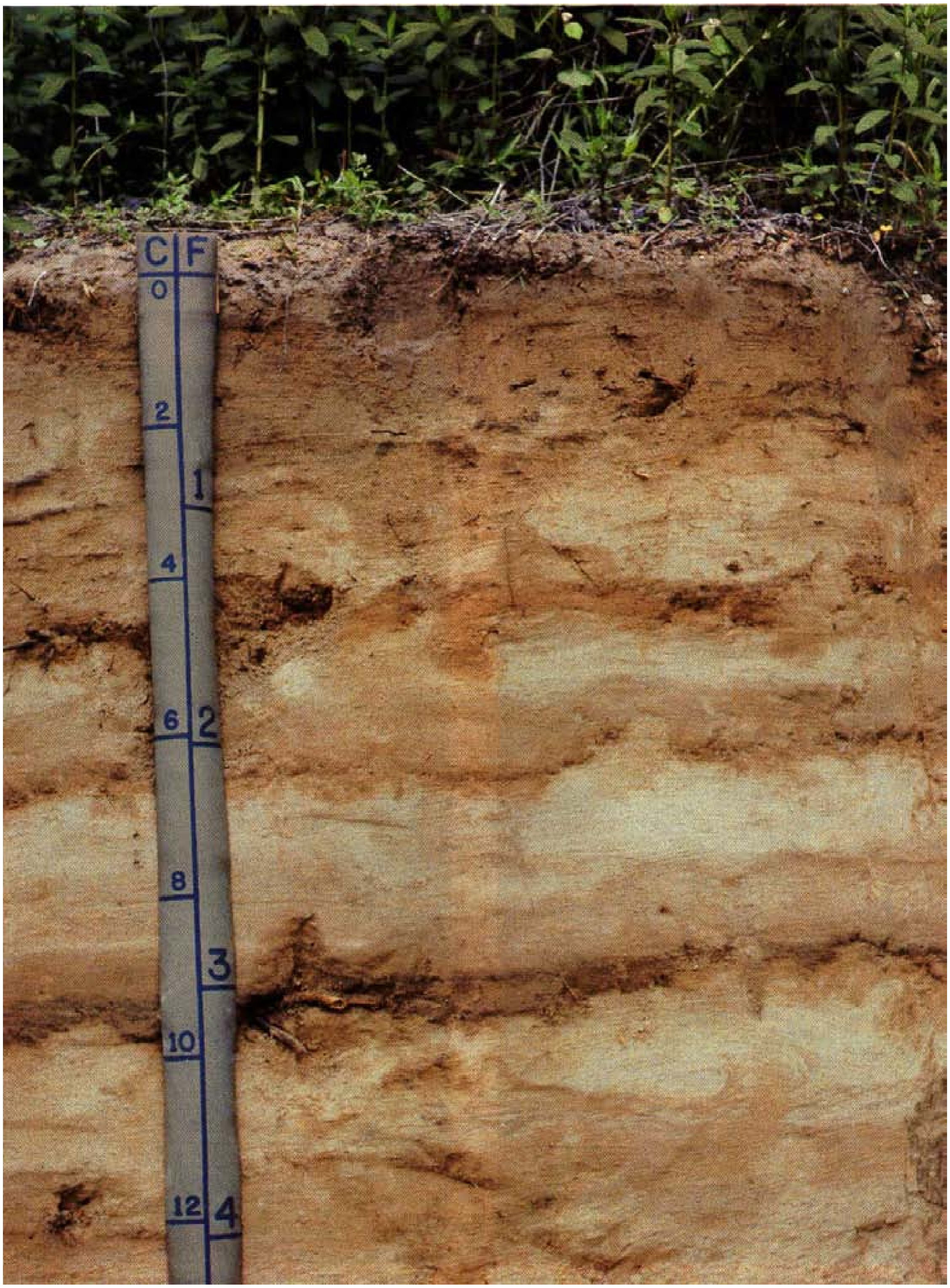

Figure 27.—Profile of Yahola loam, rarely flooded. This deep soil has developed in stratified loamy and sandy alluvium of the Brazos River flood plain.

alkaline. The Bkss horizon has common or many masses and concretions of calcium carbonate.

The Cr horizon is limestone bedrock, massive chalk with a hardness of less than 2 on the Mohs scale, or chalky marl. Some pedons are interbedded with chalky marl. The horizon is light gray or white. It is platy in the upper part and massive in the lower part.

Ferris Series

The Ferris series consists of strongly sloping or moderately steep, well drained, clayey soils on uplands. These soils are deep to weathered shale. They formed in weakly consolidated, calcareous, clayey marine sediments of Upper Cretaceous age. Slopes range from 8 to 15 percent. Soils in the Ferris series are fine, montmorillonitic, thermic Chromic Udic Haplusterts.

Typical pedon of Ferris clay, 8 to 15 percent slopes, eroded; from the intersection of Texas Highway 6 and Farm Road 1860 in Riesel, 2 miles west on Farm Road 1860 to its intersection with a county road, 0.7 mile north on the county road, in a pasture 150 feet west of the road:

A—0 to 6 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate medium and fine angular blocky structure; extremely hard, very firm, very sticky and plastic; many fine roots; few rounded siliceous pebbles $^{1}/_{4}$ to 1 inch in diameter; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bss—6 to 45 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; moderate fine angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; common prominent slickensides; vertical cracks as much as 1 inch wide and 18 inches apart and extending to a depth of 38 inches; few fine concretions and few fine powdery masses of calcium carbonate; violently effervescent; moderately alkaline; diffuse wavy boundary.

C—45 to 60 inches; yellow (2.5Y 8/8) shale with clay texture, yellow (2.5Y 7/8) moist; common coarse gray (2.5Y 5/1) mottles; massive; extremely hard, very firm, very sticky and plastic; few fine roots between shale fractures; violently effervescent; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. When the soils are dry, cracks 1 to 3 inches wide extend to a depth of more than 24 inches. The content of clay ranges from 40 to 60 percent.

The A horizon is dark grayish brown, grayish brown, light brownish gray, light olive brown, olive gray, or olive.

Some pedons have a Bw horizon. The Bss and Bw horizons are light yellowish brown, light olive brown, light gray, pale yellow, very pale brown, or light brownish gray. Gray mottles, if they occur, are inherited from the shale. The horizons have few to many concretions of calcium carbonate. In some pedons gypsum crystals are in the lower part of the B horizon.

The C horizon is light yellowish brown, olive yellow, pale yellow, or yellow. It generally has few to many coarse and prominent mottles. It is weathered shale with clay texture or is clay. The horizon has few or common concretions of calcium carbonate and gypsum.

Frio Series

The Frio series consists of very deep, nearly level, well drained, clayey soils on flood plains. These soils formed in loamy and clayey, calcareous alluvium of Holocene age. Slopes are 0 to 1 percent. Soils in the Frio series are fine, montmorillonitic, thermic Cumulic Haplustolls.

Typical pedon of Frio silty clay, occasionally flooded; from the intersection of Texas Highway 6 and Farm Road 185 about 6 miles west of Waco, 3.4 miles southeast on Farm Road 185 to Ocee, 0.7 mile northwest on a county road to Shilo Baptist Church along Hog Creek, 0.1 mile southwest in an area of grassland adjacent to the church:

A1—0 to 4 inches; brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, firm, sticky and plastic; many very fine and fine roots; few limestone fragments as much as $^{1}/_{2}$ inch in diameter; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—4 to 17 inches; very dark grayish brown (10YR 3/2) silty clay, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; many fine and common coarse and medium roots; common chert and limestone pebbles ; strongly effervescent; moderately alkaline; gradual smooth boundary.

A3—17 to 24 inches; very dark grayish brown (10YR 3/2) silty clay, very dark gray (10YR 3/1) moist; moderate medium angular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky and plastic; common fine and medium roots; common films and threads of calcium carbonate;

few concretions of calcium carbonate; few limestone fragments; strongly effervescent; moderately alkaline; diffuse smooth boundary.

Ak—24 to 42 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common very fine threads of calcium carbonate along root channels; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk—42 to 80 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; few fine and medium roots; many very fine films and threads of calcium carbonate along root channels; violently effervescent; moderately alkaline.

These soils are moderately alkaline and effervescent throughout. The texture is stratified alluvial clay, clay loam, silty clay, or silty clay loam. The content of clay ranges from 35 to 50 percent. The depth to sand, gravel, or limestone ranges from 6 to more than 30 feet.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. Some pedons have light colored, discontinuous loamy strata less than 3 inches thick. A buried A horizon is common. In some pedons postsettlement alluvium overlies the normal sequence of A horizon material. The number of films and threads of calcium carbonate ranges from few to many. Some pedons have limestone and chert fragments in some layers. The horizon is moderately alkaline and effervescent.

The B horizon is light brownish gray, light yellowish brown, brownish yellow, yellowish brown, or brown. Depth to the B horizon is more than 22 inches. Typically, it is more than 40 inches.

Gaddy Series

The Gaddy series consists of very deep, nearly level or gently sloping, somewhat excessively drained, sandy soils on flood plains. These soils formed in calcareous, sandy Holocene-age alluvium along the Brazos River. Slopes range from 0 to 2 percent. Soils in the Gaddy series are sandy, mixed, thermic Udic Ustifluvents.

Typical pedon of Gaddy loamy fine sand, in an area of Yahola-Gaddy complex, occasionally flooded; from Farm Road 434 in Downsville, 1.7 miles east on a dirt road and 0.6 mile north in an area of rangeland:

A—0 to 8 inches; brown (7.5YR 5/4) loamy fine sand, brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable; many fine and medium roots; moderately alkaline; clear smooth boundary.

C1—8 to 26 inches; reddish yellow (7.5YR 6/6) loamy fine sand; single grained; loose; common fine and medium roots; common thin bedding planes with a texture of very fine sandy loam or silt loam; slightly effervescent; moderately alkaline; gradual smooth boundary.

C2—26 to 80 inches; very pale brown (10YR 7/4) loamy fine sand, light yellowish brown (10YR 6/4) moist; thin strata and bedding planes of dark yellowish brown (10YR 4/4) fine sandy loam; slightly effervescent; moderately alkaline.

The Ap or A horizon is light yellowish brown, yellowish brown, light brown, reddish yellow, pinkish gray, brown, or dark yellowish brown loamy fine sand. Reaction is slightly alkaline or moderately alkaline.

The C horizon is very pale brown, light yellowish brown, reddish yellow, light brown, brownish yellow, or yellow. It has thin strata and bedding planes of very fine sandy loam, fine sandy loam, or silt loam in shades of brown, yellow, or red. The horizon is moderately alkaline and effervescent.

Gholson Series

The Gholson series consists of very deep, gently sloping to strongly sloping, well drained soils on stream terraces. These soils formed in loamy alluvial sediments of Pleistocene age. Slopes range from 3 to 8 percent. Soils in the Gholson series are fine-loamy, siliceous, thermic Udic Haplustalfs.

Typical pedon of Gholson fine sandy loam, 3 to 8 percent slopes; from the intersection of Farm Road 933 and Farm Road 1858 in Gholson, 1.2 miles west and 0.4 mile south on a private road, 0.4 mile east and 100 feet east of a fence in an area of pasture:

A—0 to 8 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; loose, friable; many fine and very fine roots; neutral; clear smooth boundary.

Bt1—8 to 20 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, firm; common fine roots and pores; common thin continuous clay films; slightly alkaline; gradual smooth boundary.

Bt2—20 to 31 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; few very fine roots; few medium pores; common faint clay

films on the surface of peds; few fine black concretions; slightly alkaline; gradual smooth boundary.

Bt3—31 to 48 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, friable; few very fine roots; few medium pores; few faint clay films on the surface of peds; few fine black concretions; slightly alkaline; gradual smooth boundary.

BC—48 to 72 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable; slightly alkaline; abrupt smooth boundary.

C—72 to 80 inches; reddish yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist; slightly hard, very friable; slightly alkaline.

The solum ranges from 60 to more than 80 inches in thickness. The content of clay in the control section ranges from 20 to 35 percent. The content of siliceous pebbles ranges from 0 to 5 percent.

The A horizon is brown, dark reddish gray, reddish gray, light reddish brown, light brown, grayish brown, or dark brown fine sandy loam. Reaction is slightly acid or neutral.

The Bt horizon is reddish yellow, yellowish red, red, light reddish brown, or reddish brown. Some pedons have a few yellowish or reddish mottles. The texture is sandy clay loam, loam, or clay loam. Reaction ranges from slightly acid to slightly alkaline.

The BC horizon, if it occurs, is yellowish red, light red, or reddish yellow. It is fine sandy loam, sandy clay loam, or loamy fine sand. Some pedons have a few films and threads of calcium carbonate. Reaction ranges from neutral to moderately alkaline.

The C horizon is yellowish red, light red, or reddish yellow. It varies in texture but is mainly sandy clay loam, loamy fine sand, or fine sandy loam. It has thin strata of very fine sandy loam in some pedons. Some pedons have layers or strata of sand and gravel, and some are underlain by beds of gravel. Reaction ranges from neutral to moderately alkaline.

Gowen Series

The Gowen series consists of very deep, nearly level, well drained, loamy soils on flood plains. These soils formed in loamy, noncalcareous sediments of Holocene age. Slopes are 0 to 1 percent. Soils in the Gowen series are fine-loamy, mixed, thermic Cumulic Haplustolls.

Typical pedon of Gowen clay loam, frequently flooded; from the intersection of Texas Highway 6 and Farm Road 1860 in Harrison, 2.5 miles south on Farm Road 1860 and 200 feet west of road, in an area of pasture:

Ap—0 to 12 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, firm; common fine roots; neutral; clear smooth boundary.

A1—12 to 20 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, firm; common fine roots; thin strata of siliceous pebbles as much as 1 inch in diameter; neutral; clear smooth boundary.

A2—20 to 42 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, firm; common fine and medium roots; few strata of light brown fine sandy loam about 3 inches thick; neutral; clear smooth boundary.

C1—42 to 55 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm; many fine and common medium roots; neutral; clear smooth boundary.

C2—55 to 80 inches; very pale brown (10YR 7/4) sandy clay loam, light yellowish brown (10YR 6/4) moist; few siliceous pebbles; massive; hard, firm; few fine roots; neutral.

The A horizon is dark brown, brown, grayish brown, dark grayish brown, dark gray, very dark gray, or very dark grayish brown. The surface layer is clay loam, but loam, clay loam, and sandy clay loam are common in the lower part of the A horizon. Reaction ranges from neutral to moderately alkaline.

Some pedons have a Bw or Bk horizon, which is brown, pale brown, light brownish gray, or yellowish brown clay loam, loam, sandy clay loam, or fine sandy loam. Some pedons have films and threads of calcium carbonate. Reaction ranges from neutral to moderately alkaline.

The C horizon is dark brown, brown, grayish brown, light brown, or very pale brown. It is dominantly clay loam, loam, or fine sandy loam, but some pedons have strata of fine sand containing siliceous pebbles, generally at a depth of more than 40 inches. Reaction ranges from neutral to moderately alkaline.

Heiden Series

The Heiden series consists of gently sloping or moderately sloping, well drained, cyclic, clayey soils on uplands (fig. 18). These soils are deep to weathered shale. They formed in alkaline, marine clays and material weathered from shale of Upper

Cretaceous age. Slopes range from 1 to 8 percent. Soils in the Heiden series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Heiden clay, 1 to 3 percent slopes; from the intersection of Farm Road 2114 and Interstate Highway 35 in West, 0.25 mile west on Farm Road 2114 and 150 feet north in a cropland field:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular and weak fine angular blocky structure; very hard, very firm, very sticky and plastic; common fine roots; few wormcasts; strongly effervescent; moderately alkaline; diffuse wavy boundary.

A—6 to 14 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine angular blocky structure; very hard, very firm, very sticky and plastic; few pressure surfaces; few concretions of calcium carbonate; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bss1—14 to 35 inches; dark grayish brown (10YR 4/2) clay, dark grayish brown (10YR 3/2) moist; moderate coarse angular blocky structure; very hard, very firm, very sticky and plastic; common prominent slickensides; few concretions of calcium carbonate; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bss2—35 to 45 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; common medium distinct yellowish brown (10YR 5/4) mottles; moderate coarse angular blocky structure; extremely hard, very firm, very sticky and plastic; common prominent slickensides; few concretions and masses of calcium carbonate; few fine dark concretions; few quartz pebbles as much as $^{1}/_{4}$ inch in diameter; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bkss—45 to 55 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common medium distinct yellowish brown (10YR 5/4) mottles; moderate coarse angular blocky structure; extremely hard, very firm, very sticky and plastic; many prominent slickensides; common concretions and masses of calcium carbonate; violently effervescent; moderately alkaline; diffuse wavy boundary.

C—55 to 80 inches; yellow (10YR 7/6) shale with clay texture; common medium distinct yellowish brown (10YR 5/6) and grayish brown (2.5YR 5/2) mottles; massive; extremely hard, very firm; strongly effervescent; moderately alkaline.

The solum ranges from 40 to more than 65 inches in thickness. The depth to slickensides is 14 to 25 inches. The soils are deeper in microdepressions and shallower on microknolls. In native areas, the microknolls are 3 to 10 inches higher than the microdepressions and the center of the microknolls is 8 to 16 feet from the center of the microdepressions. When the soils are dry, cracks 1 to 3 inches wide extend to a depth of more than 20 inches.

The A horizon is grayish brown, brown, dark brown, olive gray, dark olive gray, very dark grayish brown, or dark grayish brown. It is clay or gravelly clay. The gravel is mainly siliceous. This horizon is dominantly effervescent, but it is noneffervescent in some pedons. Reaction is slightly alkaline or moderately alkaline in the upper 12 inches. Some pedons in microdepressions are dark gray or very dark gray, but in less than half of the pedon and in layers less than 12 inches thick. Slickensides are common in the lower part of the A horizon.

The Bss and Bkss horizons are brown, grayish brown, pale brown, very pale brown, light olive brown, olive yellow, pale olive, light brownish gray, olive, or light yellowish brown. The number of yellowish or brownish mottles ranges from none to common. Slickensides are common. The number of concretions and masses of calcium carbonate is few or common.

The C horizon is mottled or stratified, calcareous clay, shale with clay texture, or shale in shades of gray, brown, or yellow.

Houston Black Series

The Houston Black series consists of very deep, gently sloping, moderately well drained, cyclic, clayey soils on uplands. These soils formed in alkaline, marine clays and material weathered from shale of Upper Cretaceous age. Slopes range from 0 to 3 percent. Soils in the Houston Black series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Houston Black clay, 1 to 3 percent slopes; from the intersection of Texas Highway 6 and Farm Road 1860 in Riesel, 2.0 miles east on Farm Road 1860, about 0.6 mile south and 0.2 mile west on a county road, and 50 feet north in a cropland field at the center of a microdepression:

Ap—0 to 6 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic; common fine and medium roots; common wormcasts; few fine siliceous pebbles as much as 1 inch in diameter; strongly effervescent; moderately alkaline; clear wavy boundary.

A—6 to 25 inches; very dark gray (10YR 3/1) clay,

black (10YR 2/1) moist; strong medium angular blocky structure; extremely hard, very firm; common fine and medium roots; few fine pores; common wormcasts; few prominent slickensides in the lower part; few fine pressure surfaces on peds; few fine dark concretions; few fine siliceous pebbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bss—25 to 35 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; strong coarse angular blocky structure; extremely hard, very firm, very sticky and plastic; common fine and medium roots; common prominent slickensides; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bkss1—35 to 65 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; strong coarse angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots on the surface of peds; few wormcasts; common prominent slickensides; common fine concretions of calcium carbonate; few fine siliceous pebbles; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkss2—65 to 75 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; common prominent slickensides; common fine concretions and masses of calcium carbonate; violently effervescent; moderately alkaline; diffuse wavy boundary.

C—75 to 80 inches; yellow (10YR 7/6) shale with clay texture; common medium distinct yellowish brown (10YR 5/6) and grayish brown (2.5YR 5/2) mottles; strong medium and fine angular blocky rock structure; extremely hard, very firm, very sticky and plastic; few fine roots; few fine dark concretions about $^{1}/_{8}$ inch in diameter; common concretions and masses of calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 60 to more than 100 inches in thickness. The depth to slickensides is 16 to 25 inches. The texture is clay or silty clay throughout the profile. When the soils are dry, cracks 1 to 4 inches wide extend from the surface to a depth of more than 20 inches. Cycles of microdepressions and microknolls occur every 16 to 24 feet. In native areas the microknolls are 3 to 12 inches higher than the microdepressions. The soils typically are effervescent and moderately alkaline throughout, but in some microdepressions the upper 12 inches is noneffervescent and is slightly alkaline or moderately alkaline.

The A horizon is very dark gray, dark gray, or black. When the soils are dry, the surface has a granular mulch about 1 centimeter thick.

The Bss horizon is dark gray, gray, very dark gray, or black. It has few or common dark gray, dark grayish brown, grayish brown, or olive yellow mottles in most pedons.

The Bkss horizon is dark grayish brown, grayish brown, brownish gray, light olive brown, or olive yellow or is mottled in shades of brown or gray. The horizon has few or common accumulations of calcium carbonate in the form of masses, films, threads, and concretions.

The C horizon is yellowish brown, olive brown, light yellowish brown, or yellow. It has few or common grayish, brownish, or yellowish mottles in most pedons. It is clay or shale with clay texture.

Krum Series

The Krum series consists of very deep, gently sloping or moderately sloping, well drained, clayey soils on low terraces and infilled valleys of Pleistocene age (fig. 19). These soils formed in calcareous, clayey alluvial and colluvial sediments. Slopes range from 2 to 5 percent. Soils in the Krum series are fine, montmorillonitic, thermic Udertic Haplustolls.

Typical pedon of Krum silty clay, 2 to 5 percent slopes; from the intersection of Farm Road 938 and Farm Road 185 about 4.3 miles west of Crawford, 1.7 miles southeast on Farm Road 938 to its intersection with a county road, 0.75 mile northeast on the county road, and 100 feet southwest along a tributary of Tonk Creek:

A1—0 to 6 inches; dark brown (7.5YR 4/2) silty clay, very dark brown (7.5YR 3/2) moist; moderate medium granular and subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few fine pores; few very fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—6 to 24 inches; dark brown (7.5YR 4/2) silty clay, very dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; peds with shiny pressure surfaces in the lower part; hard, firm, sticky and plastic; few fine roots; few fine pores; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bw—24 to 42 inches; light brown (7.5YR 6/4) silty clay, brown (7.5YR 5/4) moist; moderate medium

angular blocky structure; hard, very firm, sticky and plastic; common fine roots; few fine pores; few shiny pressure surfaces on peds; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk—42 to 50 inches; reddish yellow (7.5YR 6/6) silty clay, strong brown (7.5YR 5/6) moist; moderate medium angular blocky structure; hard, firm, sticky and plastic; few fine roots; about 5 percent, by volume, fine concretions and masses of calcium carbonate; 10 percent, by volume, limestone pebbles as much as $2^1/_2$ inches in diameter; violently effervescent; moderately alkaline; diffuse wavy boundary.

BCk1—50 to 65 inches; reddish yellow (7.5YR 6/6) gravelly silty clay loam, strong brown (7.5YR 5/6) moist; weak medium angular blocky structure; hard, firm, sticky and plastic; common fine concretions and masses of calcium carbonate; 15 percent, by volume, limestone pebbles as much as $2^1/_2$ inches in diameter; violently effervescent; moderately alkaline; diffuse wavy boundary.

BCk2—65 to 80 inches; reddish yellow (7.5YR 6/6) silty clay loam, strong brown (7.5YR 5/6) moist; massive; hard, firm, sticky and plastic; common fine concretions and masses of calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness. When the soils are dry, cracks 0.4 inch to 1.2 inches wide extend from the surface to a depth of about 24 to 48 inches. The content of clay in the control section ranges from 40 to 60 percent.

The A horizon is 16 to 36 inches thick. It is very dark grayish brown, dark grayish brown, grayish brown, dark gray, brown, or dark brown. The texture is silty clay or clay. Reaction is slightly alkaline or moderately alkaline.

The Bw horizon is brown, grayish brown, pale brown, yellowish brown, light yellowish brown, light brown, or reddish brown. It is clay or silty clay. Some pedons have as much as 15 percent, by volume, concretions and masses of calcium carbonate. Reaction is slightly alkaline or moderately alkaline.

The BCk horizon is pale brown, yellowish brown, brownish yellow, strong brown, or reddish yellow. It is silty clay loam, silty clay, or clay. The content of calcium carbonate segregations ranges from 2 to 20 percent, by volume. Reaction is moderately alkaline.

The Ck horizon is pale brown, light yellowish brown, brownish yellow, reddish yellow, or light reddish brown. It is silty clay loam, silty clay, or clay. It has few or common concretions and masses of calcium carbonate.

Lamar Series

The Lamar series consists of very deep, gently sloping or moderately sloping, well drained, loamy soils on upland terraces of Pleistocene age. These soils formed in calcareous, loamy sediments. Slopes range from 3 to 8 percent. Soils in the Lamar series are fine-silty, mixed, thermic Udic Ustochrepts.

Typical pedon of Lamar clay loam, 3 to 8 percent slopes; from the intersection of Texas Highway 185 and Farm Road 1637 about 2.4 miles south of China Spring, 1.3 miles northeast on Farm Road 1637 to its intersection with a county road, 2.8 miles northeast on the county road to Rock Creek Store at Farm Road 3434, about 0.9 mile south on Farm Road 3434, and 200 feet east in an area of pasture:

A1—0 to 6 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable; common fine and medium roots; slightly effervescent; moderately alkaline; clear smooth boundary.

A2—6 to 17 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate fine granular and subangular blocky structure; hard, friable; common fine and medium roots; slightly effervescent; moderately alkaline; clear smooth boundary.

Bk1—17 to 30 inches; brownish yellow (10YR 6/6) loam, yellowish brown (10YR 5/6) moist; moderate fine granular and moderate medium subangular blocky structure; hard, friable; few fine roots; few masses of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk2—30 to 44 inches; brownish yellow (10YR 6/6) loam, brownish yellow (10YR 6/6) moist; few fine and medium strong brown (7.5YR 5/6) mottles; moderate fine prismatic structure parting to medium subangular blocky; hard, friable; few fine roots; few concretions of calcium carbonate; common masses of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Ck1—44 to 52 inches; brownish yellow (10YR 6/6) loam, brownish yellow (10YR 6/6) moist; common distinct yellow (10YR 7/8) mottles; massive; hard, friable; common concretions of calcium carbonate; violently effervescent; moderately alkaline; gradual smooth boundary.

Ck2—52 to 80 inches; yellow (10YR 8/6) loam, yellow (10YR 7/6) moist; common medium faint light gray (10YR 7/1) mottles; massive; hard, friable; common concretions of calcium carbonate; common masses of calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 20 to 50 inches in thickness. The soils are dominantly effervescent and moderately alkaline, but some pedons are noneffervescent and neutral in the surface layer.

The A horizon is brown, dark brown, dark grayish brown, grayish brown, pale brown, or light yellowish brown. It is loam or clay loam.

The B horizon is loam, silty clay loam, or clay loam. Mottles in this horizon have colors in shades of yellow or brown. The Bk1 horizon is yellow, brownish yellow, light yellowish brown, pale brown, or light yellowish brown. The Bk2 horizon is yellow, light reddish brown, or dark brown.

The C horizon is yellow or brownish yellow. It is loam or clay loam. In most pedons it has accumulations of calcium carbonate.

Lewisville Series

The Lewisville series consists of very deep, gently sloping, well drained, clayey soils on the lower terraces of Pleistocene-age (fig. 20). These soils formed in calcareous, clayey alluvial sediments. Slopes range from 1 to 3 percent. Soils in the Lewisville series are fine-silty, mixed, thermic Udic Calciustolls.

Typical pedon of Lewisville silty clay, 1 to 3 percent slopes; from the intersection of Texas Highway 317 and Farm Road 185 in Crawford, 1.5 miles north on Farm Road 185, and 200 feet east in an area of cropland:

Ap—0 to 12 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, firm; common fine roots; few siliceous pebbles as much as 1/2 inch in diameter; slightly effervescent; moderately alkaline; clear smooth boundary.

A—12 to 20 inches; brown (7.5YR 5/2) silty clay, very dark brown (7.5YR 4/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine roots; few fine pores; few fine concretions of calcium carbonate; slightly effervescent; moderately alkaline; gradual smooth boundary.

Bk1—20 to 52 inches; light brown (7.5YR 5/4) silty clay, brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine roots; few fine pores; common films and threads of calcium carbonate; few masses of calcium carbonate; few siliceous pebbles as much as 1/2 inch in diameter; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk2—52 to 70 inches; pink (7.5YR 7/4) gravelly silty clay loam, light brown (7.5YR 6/4) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine roots; few fine pores; common fine concretions and masses of calcium carbonate; few siliceous and limestone pebbles as much as 1/2 inch in diameter; strongly effervescent; moderately alkaline; gradual smooth boundary.

C—70 to 80 inches; reddish yellow (7.5YR 7/6) silty clay loam, reddish yellow (7.5YR 6/6) moist; massive, hard, firm; few fine roots; about 30 percent, by volume, concretions and masses of calcium carbonate; common limestone pebbles as much as 1 inch in diameter; few siliceous pebbles as much as 1/2 inch in diameter; violently effervescent; moderately alkaline.

The solum is more than 60 inches thick. The mollic epipedon is 10 to 20 inches thick. Depth to the calcic horizon ranges from 10 to 20 inches. The content of silicate clay ranges from 25 to 35 percent. The calcium carbonate equivalent ranges from 20 to 40 percent.

The A horizon is dark brown, grayish brown, dark grayish brown, or brown silty clay. The content of siliceous pebbles is 0 to about 3 percent, by volume.

The Bk1 horizon is brown, yellowish brown, light yellowish brown, pale brown, grayish brown, or light yellowish brown. The Bk2 horizon is pink, brown, light yellowish brown, strong brown, or reddish yellow. The B horizon is silty clay, clay loam, silty clay loam, or the gravelly counterparts of those textures.

The C horizon is pale brown, light brown, reddish yellow, or pink. The content of visible carbonates ranges from 3 to 30 percent.

Lott Series

The Lott series consists of very deep, gently sloping to strongly sloping, clayey soils on uplands (fig. 21). These soils formed in residuum derived from flaggy limestone that is interbedded with clay or chalky marl and is of Upper Cretaceous age. Slopes range from 1 to 8 percent. Soils in the Lott series are fine-silty, carbonatic, thermic Udorthenic Haplustolls.

Typical pedon of Lott silty clay, 1 to 5 percent slopes; from the intersection of Texas Highway 6 and

Farm Road 185 about 6 miles west of Waco, 0.6 mile north on Farm Road 185, then 0.3 mile east and 250 feet north in an area of cropland:

Ap—0 to 5 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable; few very fine roots; few very fine pores; strongly effervescent; moderately alkaline; clear smooth boundary.

A—5 to 12 inches; brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, firm; few fine roots; few fine pores; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—12 to 36 inches; brown (7.5YR 5/4) silty clay, brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm; about 4 percent masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—36 to 48 inches; reddish yellow (7.5YR 6/6) silty clay, strong brown (7.5YR 5/6) moist; weak fine subangular blocky structure; hard, firm; about 4 percent masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

BCk—48 to 52 inches; reddish yellow (7.5YR 7/8) silty clay loam, reddish yellow (7.5YR 6/8) moist; few fine faint light brown mottles; weak fine subangular blocky structure; hard, firm; many masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

C—52 to 80 inches; reddish yellow (7.5YR 7/8) silty clay loam interbedded with reddish yellow (7.5YR 6/8), clayey marl; massive; many masses of calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. Between depths of 10 and 40 inches, the calcium carbonate equivalent is 45 to 80 percent and the content of silicate clay is 25 to 35 percent. In most pedons a few pebbles are on and below the surface.

The A horizon is dark brown, brown, grayish brown, dark brown, or dark grayish brown silty clay.

The Bk horizon is brown, grayish brown, pale brown, light brownish gray, yellowish brown, or reddish yellow. It is silty clay loam or silty clay. Mottles in the B horizon are in shades of brown or yellow. The horizon has few or common masses of calcium carbonate.

The BCk horizon, if it occurs, is mottled in shades of yellow, brown, white, or gray. It is platy or massive, chalky marl, shale with clay texture, clay, or marly clay. It has common or many masses of calcium carbonate.

The C horizon is yellowish, brownish, light gray, or white. It is silty clay loam, silt loam, clayey marl, or chalky marl. Some pedons have few or common fragments of limestone.

Mabank Series

The Mabank series consists of very deep, nearly level, moderately well drained, loamy soils on smooth uplands. These soils formed in clayey alluvial deposits on high terraces of Pleistocene age. Slopes are 0 to 1 percent. Soils in the Mabank series are fine, montmorillonitic, thermic Oxyaquic Vertic Paleustalfs.

Typical pedon of Mabank fine sandy loam, in an area of Mabank-Bremond complex, 0 to 1 percent slopes; from the intersection of Interstate Highway 35 and Farm Road 308 in Elm Mott, 2.2 miles east on Farm Road 308 and 125 feet north of road, in an area of pasture:

Ap—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; very hard, friable; many fine and very fine and common medium roots; common fine pores; neutral; abrupt wavy boundary.

Btg—7 to 26 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; extremely hard, very firm; common very fine and fine roots; common thin distinct clay films on the surface of peds; few pressure faces; slightly alkaline; gradual smooth boundary.

Btyg1—26 to 36 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate medium angular blocky structure; extremely hard, very firm; common distinct clay films on the surface of peds; few masses of calcium carbonate; common masses of gypsum crystals; few fine dark concretions; moderately alkaline; gradual smooth boundary.

Btyg2—36 to 60 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak medium angular blocky structure; extremely hard, very firm; common distinct clay films on the surface of peds; common masses of calcium carbonate and gypsum crystals; few fine dark concretions; moderately alkaline; gradual smooth boundary.

BCy—60 to 80 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common masses of calcium carbonate and gypsum crystals; few fine dark concretions; moderately alkaline.

The solum ranges from 60 to more than 80 inches

in thickness. When the soils are dry, cracks 1/8 inch or more wide form in the upper part of the subsoil. The content of clay in the control section ranges from 35 to 50 percent. The soils are noncalcareous in the upper part of the solum and calcareous in the lower part of the subsoil.

The thickness of the A horizon averages less than 8 inches but ranges from 6 to 11 inches. This horizon is dark grayish brown, very dark gray, dark gray, gray, or grayish brown fine sandy loam. Reaction is slightly acid or neutral.

The Bt horizon is very dark gray, black, or dark gray. It is clay loam or clay. Reaction ranges from moderately acid to slightly alkaline.

The Btyg horizon is light brownish gray, grayish brown, dark grayish brown, gray, or dark gray. It is clay loam or clay. Concretions of calcium carbonate and gypsum concretions are common. Reaction ranges from moderately acid to moderately alkaline.

The BC horizon is light brownish gray, gray, light gray, or grayish brown. It is clay loam or clay. Reaction ranges from neutral to moderately alkaline. Some pedons have a few quartz pebbles and gypsum crystals.

McLennan Series

The McLennan series consists of very deep, strongly sloping or moderately steep, well drained, clayey soils on uplands. These soils formed in clay or claystone that is interbedded with flaggy limestone and is of Upper Cretaceous age. Slopes range from 8 to 15 percent. Soils in the McLennan series are fine-silty, carbonatic, thermic Udic Ustochrepts.

Typical pedon of McLennan clay loam, 8 to 15 percent slopes; from the intersection of Texas Highway 317 and Farm Road 107 in Moody, 2.8 miles north on Texas Highway 317 to its intersection with an unpaved county road, 2.0 miles north on the county road and 150 feet west of road, in an area of pasture:

A—0 to 7 inches; grayish brown (2.5YR 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine subangular blocky structure; hard, friable; common very fine and fine roots; common wormcasts; few fragments of limestone 5 to 10 inches across; calcium carbonate equivalent of 50 percent; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw—7 to 14 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate subangular blocky; hard, firm; common very fine and fine roots; calcium carbonate equivalent of 70 percent; few medium concretions of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bk1—14 to 24 inches; light yellowish brown (2.5Y 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate medium prismatic structure parting to moderate very fine subangular blocky; hard, firm; few very fine and fine roots; calcium carbonate equivalent of 70 percent; common medium concretions of calcium carbonate; few medium masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—24 to 32 inches; light yellowish brown (2.5Y 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate medium prismatic structure parting to moderate very fine subangular blocky; hard, firm; few very fine and fine roots; calcium carbonate equivalent of 70 percent; common medium concretions of calcium carbonate; common medium masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bk/C—32 to 80 inches; olive yellow (2.5Y 6/6) silty clay loam interbedded with quartzitic limestone 1 to 4 inches thick; weak coarse angular rocklike structure; mixed with weathered shale or claystone; extremely hard, very firm; few fine roots; calcium carbonate equivalent of 70 percent; common medium masses and concretions of calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness. The soils are calcareous and have a calcium carbonate equivalent of 40 to more than 80 percent. The texture is silty clay, silty clay loam, or clay loam throughout the profile. The total clay content ranges from 35 to 50 percent, and the content of silicate clay ranges from 25 to 35 percent.

The A horizon is light yellowish brown, grayish brown, light brownish gray, pale brown, or brown. The content of channery or flaggy limestone fragments ranges from a few to about 10 percent, by volume. The fragments range from 5 millimeters to about 20 centimeters across the long axis.

The B horizon is yellowish brown, olive yellow, pale brown, light yellowish brown, brownish yellow, or light olive brown. Some pedons have gray mottles that are inherited from the parent material. The content of calcium carbonate masses ranges from a few in the upper part of the horizon to about 35 percent, by volume, in the lower part. The content of calcium carbonate concretions ranges from 0 to about 10 percent, by volume.

The Bk/C horizon is olive yellow, light olive brown, brownish yellow, pale olive, or yellow. It has strata of limestone, 1 to 4 inches thick, interbedded with clay, claystone, siltstone, silty clay loam, clay loam, or loam. The horizon has few or common masses and concretions of calcium carbonate.

Minwells Series

The Minwells series consists of very deep, gently sloping, well drained, loamy soils on stream terraces (fig. 22). These soils formed in clayey and gravelly sediments of Pleistocene age. Slopes range from 1 to 5 percent. Soils in the Minwells series are fine, mixed, thermic Udic Paleustalfs.

Typical pedon of Minwells fine sandy loam, 1 to 3 percent slopes; from the intersection of Texas Highway 317 and Texas Highway 6 in Valley Mills, 4.4 miles east on Texas Highway 6 to Delmar Ranch, 2.5 miles north on a gravel road, 0.6 mile west, and 150 feet north in an area of pasture.

A—0 to 8 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; loose, friable; few fine and medium roots; many very fine pores; neutral; abrupt smooth boundary.

Bt1—8 to 25 inches; reddish brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) moist; common medium distinct red (2.5YR 5/6) mottles; moderate coarse prismatic structure parting to subangular blocky; very hard, firm; few medium roots; few distinct clay films on the surface of peds; slightly alkaline; clear smooth boundary.

Bt2—25 to 38 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; common medium distinct red (2.5YR 4/8) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm; few very fine roots; common distinct clay films on the surface of peds; neutral; clear smooth boundary.

Bt3—38 to 55 inches; red (2.5YR 5/6) sandy clay, red (2.5YR 4/6) moist; many medium distinct red (2.5YR 5/8) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm; few distinct clay films on the surface of peds; slightly acid; gradual wavy boundary.

Bt4—55 to 60 inches; light red (2.5YR 6/8) sandy clay, red (2.5YR 5/8) moist; common prominent coarse red (2.5YR 5/6) mottles; weak fine subangular blocky structure; hard, firm; few distinct clay films on the surface of peds; slightly alkaline; gradual wavy boundary.

BC—60 to 65 inches; reddish yellow (7.5YR 7/6) gravelly sandy clay loam, reddish yellow (7.5YR 6/6) moist; weak fine subangular blocky structure; hard, friable; 30 percent rounded limestone pebbles as much as 2 inches in diameter; few siliceous pebbles as much as 1/4 inch in diameter; slightly alkaline; gradual wavy boundary.

2C—65 to 80 inches; reddish yellow (7.5YR 7/6) very gravelly sandy clay loam, reddish yellow (7.5YR 6/6) moist; massive; hard, friable; many siliceous pebbles and limestone fragments as much as 2 inches in size; few coatings of calcium carbonate on gravel fragments; strongly effervescent; moderately alkaline.

The solum ranges from 60 to about 80 inches in thickness. The depth to beds of gravel ranges from 40 to about 70 inches. The depth to accumulations of calcium carbonate ranges from 40 to 65 inches.

The A horizon is dark brown, pale brown, light brown, or brown fine sandy loam. The content of siliceous pebbles ranges from 0 to 10 percent, by volume. Reaction ranges from slightly acid to moderately alkaline.

The Bt horizon is reddish brown, red, or yellowish red. It is clay, sandy clay, or sandy clay loam. Reaction ranges from slightly acid to moderately alkaline. The content of clay in the upper 20 inches ranges from 35 to 45 percent. The horizon has few or common siliceous pebbles.

The BC horizon has colors in shades of red, brown, or yellow. In some pedons it has few or common mottles of these colors. It is clay, sandy clay, clay loam, sandy clay loam, or the gravelly counterparts of those textures. The content of siliceous pebbles, mainly less than 6 inches across, ranges from 0 to 35 percent, by volume. Reaction ranges from neutral to moderately alkaline.

The 2C horizon has colors in shades of brown, red, or yellow. It ranges from sand to sandy clay loam or is the gravelly or very gravelly counterparts of the textures within that range. In some pedons it grades to beds of gravel. Reaction ranges from neutral to moderately alkaline.

Oglesby Series

The Oglesby series consists of shallow, gently sloping, well drained, clayey soils on uplands. These soils formed in residuum over limestone of Lower Cretaceous age. Slopes range from 1 to 3 percent. Soils in the Oglesby series are clayey, montmorillonitic, thermic Lithic Haplustolls.

Typical pedon of Oglesby silty clay, 1 to 3 percent slopes; from the intersection of Texas Highway 317 and Farm Road 185 in Crawford, 0.4 mile west on

Farm Road 185 to its intersection with Prairie Chapel Road, 4.7 miles northwest on Prairie Chapel Road, and 0.3 mile north in an area of pasture:

A1—0 to 6 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine granular and moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine and medium roots; slightly alkaline; gradual smooth boundary.

A2—6 to 18 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate medium angular and subangular blocky structure; hard, firm, sticky and plastic; common fine and few medium roots; common fine pores; slightly alkaline; abrupt wavy boundary.

R—18 to 35 inches; indurated limestone with a hardness of 4 or more on the Mohs scale; coarse fractures filled with soil material in the upper part; few fractures in the lower part.

The solum ranges from 10 to 20 inches in thickness. The average clay content is 40 to 50 percent. Limestone fragments less than 3 inches to about 10 inches across cover 0 to 10 percent on the surface and make up as much as about 10 percent, by volume, of the solum. Reaction ranges from neutral to moderately alkaline, and the soils are noneffervescent.

The A horizon is dark brown, dark grayish brown, very dark grayish brown, very dark brown, or dark brown. It is silty clay or clay.

The limestone bedrock in the R layer generally cannot be excavated with a backhoe machine. The upper part of the bedrock has fractures, which decrease with increasing depth.

Ovan Series

The Ovan series consists of very deep, nearly level, moderately well drained, clayey soils on flood plains. These soils formed in calcareous, clayey alluvium. Slope is less than 1 percent. Soils in the Ovan series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Ovan silty clay, frequently flooded; from the intersection of Texas Highway 6 and Farm Road 1860 in Riesel, 0.6 mile west of Farm Road 1860 to its intersection with a county road, 1.6 miles north and west on the county road, and 200 feet north in an area of pasture:

A1—0 to 20 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; very hard, very firm, very sticky and plastic; many very fine and fine and common medium and coarse roots; few fine and medium siliceous pebbles; slightly effervescent; moderately alkaline; clear wavy boundary.

A2—20 to 35 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium angular blocky structure; very hard, very firm; common medium and coarse roots; many pressure faces; common masses of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

Bss1—35 to 48 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; common fine faint dark grayish brown (10YR 4/2) mottles; moderate medium angular blocky structure; very hard, very firm; common coarse roots; common prominent slickensides; few masses of calcium carbonate; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bss2—48 to 65 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; common fine faint dark grayish brown (10YR 4/2) mottles; moderate medium angular blocky structure; very hard, very firm; few coarse roots; common prominent slickensides; few masses of calcium carbonate; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bkss—65 to 80 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; moderate medium angular blocky structure; very hard, very firm; few prominent slickensides; few siliceous pebbles as much as 2 inches in diameter; few limestone fragments as much as 2 inches in diameter; common threads and few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. When the soils are dry, cracks 1 to 3 inches wide extend from the surface to a depth of more than 2 feet. The soils are effervescent and moderately alkaline throughout. Many siliceous pebbles ranging from $^{1}/_{4}$ inch to $2^{1}/_{2}$ inches in diameter occur laterally in the pedon but are continuous for only a few feet in a given part of the pedon. A few thin flags of sandstone are mixed with the siliceous pebbles.

The A horizon is very dark grayish brown, brown, dark grayish brown, or grayish brown. It is silty clay or clay.

The B horizon is brown, grayish brown, light brownish gray, dark grayish brown, or pale brown. Some pedons have dark grayish brown mottles. The texture is silty clay or clay.

Some pedons have a C horizon, which is stratified clay, silty clay, or clay loam and is gray, brown, or olive.

Payne Series

The Payne series consists of very deep, gently sloping, well drained, loamy soils on uplands. These soils are in smooth areas in drainageways. They are on the highest part of the landscape. They formed in alluvium of Pleistocene age. Slopes range from 1 to 3 percent. Soils in the Payne series are fine, montmorillonitic, thermic Udic Paleustalfs.

Typical pedon of Payne clay loam, 1 to 3 percent slopes; from the intersection of Farm Road 1637 and Farm Road 3051 in Bosqueville, 0.6 mile west on Farm Road 1637 and 50 feet north of road, in an area of grassland:

A—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, dark brown (10YR 3/3) moist; massive when dry; weak medium granular structure when moist; very hard, firm; many fine roots; slightly acid; abrupt wavy boundary.

Bt1—8 to 20 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate fine angular blocky structure; very hard, very firm; common fine roots; few fine pores; many prominent clay films on the surface of peds; neutral; gradual wavy boundary.

Bt2—20 to 30 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak coarse angular blocky structure; very hard, very firm; few fine roots and pores; few prominent clay films on the surface of peds; slightly alkaline; gradual smooth boundary.

Btk—30 to 45 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; common medium distinct yellowish red and light brown mottles; weak coarse angular blocky structure; very hard, very firm, sticky and plastic; few faint clay films on the surface of peds; few fine concretions of calcium carbonate; slightly effervescent; moderately alkaline; gradual smooth boundary.

BCk—45 to 72 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; weak coarse angular blocky structure; hard, firm; common masses and concretions of calcium carbonate as much as $^{1}/_{2}$ inch in diameter; strongly effervescent; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness. The depth to powdery masses of calcium carbonate is 28 to 50 inches. In some pedons 15 to 20 percent of the surface is covered with rounded siliceous pebbles and cobbles as much as 6 inches in diameter.

The A horizon is dark grayish brown, grayish brown, very dark grayish brown, brown, or dark brown clay loam. Reaction is slightly acid or neutral.

The Bt horizon is dark reddish brown, reddish brown, dark brown, brown, reddish yellow, yellowish red, dark yellowish brown, or red. It is clay or clay loam. Reaction ranges from slightly acid to slightly alkaline.

The Btk and BCk horizons have colors in shades of red or brown and in some pedons have mottles of these colors. The texture is clay or clay loam. The horizons have few or common concretions and masses of calcium carbonate and are strongly effervescent. Reaction is moderately alkaline. In some pedons gravel beds are at a depth of 6 to 10 feet.

Purves Series

The Purves series consists of shallow, gently sloping, well drained, clayey soils on uplands (fig. 23). These soils formed in residuum derived from limestone that is interbedded with calcareous clays and is of Lower Cretaceous age. Slopes range from 1 to 3 percent. Soils in the Purves series are clayey, montmorillonitic, thermic Lithic Calciustolls.

Typical pedon of Purves clay, 1 to 3 percent slopes; from the intersection of U.S. Highway 84 and Texas Highway 317 in McGregor, 3.3 miles west on U.S. Highway 84 to Farm Road 938, about 1.7 miles north on Farm Road 938, about 2.0 miles east on a county road, and 50 yards north in an area of cropland:

Ap—0 to 4 inches; brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; few fine and medium roots; about 10 percent of the surface covered with limestone pebbles and cobbles 1 to 5 inches in diameter; strongly effervescent; moderately alkaline; gradual wavy boundary.

A—4 to 9 inches; brown (7.5YR 4/2) gravelly clay, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; few medium roots; few concretions of calcium carbonate; 20 percent, by volume, limestone fragments as much as 6 inches across; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk—9 to 15 inches; brown (7.5YR 4/2) very gravelly clay, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; 40 percent limestone

fragments with coatings of dark reddish brown (5YR 3/2) clay; about 5 percent pendants and coatings of calcium carbonate on the lower side of limestone fragments; strongly effervescent; moderately alkaline; abrupt irregular boundary.

R—15 to 35 inches; fractured limestone bedrock interbedded with chalky marl, weakly cemented limestone, and clay; dark brown (7.5YR 3/2) clay filling crevices in the fractured upper 2 inches of the limestone bedrock.

The solum ranges from 10 to 20 inches in thickness. The content of limestone fragments 1/2 inch to 10 inches across the long axis is 5 to 35 percent, by volume. The content of clay ranges from 35 to 50 percent. Some pedons have a few chert fragments. The solum is moderately alkaline and effervescent.

The A horizon is dark brown, dark grayish brown, or grayish brown. It is clay, silty clay, or the gravelly counterparts of those textures.

The Bk horizon, if it occurs, has the same colors as the A horizon. The texture of the Bk horizon is gravelly or very gravelly clay. Pendants on the underside of limestone fragments make up 1 to 10 percent of the volume.

The R layer is fractured, indurated limestone that has a hardness of more than 3 on the Mohs scale. In some pedons the limestone is interbedded with marl.

Queeny Series

The Queeny series consists of very shallow or shallow, gently sloping, well drained, loamy soils on high terraces. These soils formed in calcareous, loamy and clayey material underlain by gravelly sediments of Pleistocene age. Slopes range from 1 to 5 percent. Soils in the Queeny series are loamy, mixed, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of the Queeny clay loam, 1 to 5 percent slopes; from the intersection of Farm Road 185 and Texas Highway 317 in Crawford, 2.0 miles east on Farm Road 185 to a county road, 3.6 miles south on the county road, and 400 feet north in an abandoned gravel pit:

A—0 to 12 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable; many fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bkm—12 to 20 inches; white (10YR 8/2), strongly cemented caliche containing common embedded siliceous and limestone pebbles; caliche plates are mostly 8 to 15 inches long and 2 to 4 inches thick; fractures filled with brown (7.5YR 4/2) clay loam; violently effervescent; moderately alkaline; clear wavy boundary.

BCk—20 to 60 inches; white (10YR 8/2), weakly cemented caliche containing embedded siliceous and limestone fragments and stratified with brownish yellow (10YR 6/6) very gravelly sand containing about 60 percent limestone and siliceous gravel; few masses of calcium carbonate; violently effervescent.

The solum ranges from 4 to 20 inches in thickness. It has 5 to 25 percent siliceous pebbles and limestone fragments, by volume.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. The content of siliceous and limestone gravel ranges from 5 to 15 percent.

The Bkm is hardened, cemented caliche that has limestone and quartz pebbles. In some pedons the cemented layer is discontinuous and fractured.

The BCk horizon is stratified gravel or sand and gravel. Some pedons have a few stone- and boulder-size fragments. Most pedons have 60 to 80 percent fragments of quartz and limestone, by volume. The fine-earth fraction is sand, clay loam, or silty clay loam.

Some pedons have a 2C horizon, which is stratified gravel.

Real Series

The Real series consists of shallow, moderately steep or steep, well drained, loamy soils on uplands. These soils formed in material weathered from interbedded limestone and marl of Lower Cretaceous age. Slopes range from 10 to 30 percent. Soils in the Real series are loamy-skeletal, carbonatic, thermic, shallow Typic Calciustolls.

Typical pedon of Real gravelly clay loam, in an area of Real-Rock outcrop complex, 10 to 30 percent slopes; from the intersection of Texas Highway 6 and Texas Highway 317 in Valley Mills, 0.8 mile south on Texas Highway 6 to River Estates Road, 0.6 mile east on River Estates Road, then 0.2 mile north and 50 feet west, in a road cut:

A—0 to 6 inches; dark brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, friable; many very fine and fine roots; many fine pores; few concretions of calcium carbonate; about 20 percent fragments of

limestone 1/2 inch to 2 inches in diameter; strongly effervescent; moderately alkaline; clear smooth boundary.

ABk—6 to 14 inches; dark brown (10YR 4/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, friable; many very fine and fine roots; common concretions of calcium carbonate; about 55 percent fragments of limestone 1/2 inch to 3 inches in diameter; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Crk—14 to 40 inches; weakly and strongly cemented limestone interbedded with calcareous clay loam; few fine roots in fractures.

The solum ranges from 9 to 20 inches in thickness. Rock fragments make up 35 to 85 percent of the soils. They are limestone fragments ranging from 1/8 inch to 10 inches in diameter. The content of silicate clay ranges from 25 to 35 percent. The calcium carbonate equivalent ranges from 40 to 70 percent. The texture is very gravelly or extremely gravelly loam or clay loam.

The A horizon is dark brown, grayish brown, dark grayish brown, very dark grayish brown, or brown. The ABk horizon is gravelly or very gravelly clay loam.

The Crk horizon is pale yellow, light yellowish brown, light gray, or white limestone interbedded with marl or clay loam.

Riesel Series

The Riesel series consists of very deep, gently sloping, well drained, loamy soils on stream terraces. These soils formed in gravelly and clayey alluvial sediments of Pleistocene age. Slopes range from 1 to 3 percent. Soils in the Riesel series are clayey-skeletal, mixed, thermic Udic Paleustalfs.

Typical pedon of Riesel gravelly fine sandy loam, 1 to 3 percent slopes; from the intersection of Farm Road 2860 and Texas Highway 6 in Riesel, 1.2 miles north on Texas Highway 6, about 0.1 mile east on a dirt road, and 65 feet north in a wooded pasture:

A1—0 to 6 inches; dark brown (7.5YR 4/2) gravelly fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; common fine and very fine roots; common fine and very fine pores; 30 percent, by volume, siliceous pebbles 1/4 inch to 3 1/2 inches in diameter; neutral; clear smooth boundary.

E—6 to 16 inches; brown (7.5YR 5/4) very gravelly fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; hard, friable; common fine roots; 40 percent, by volume, siliceous pebbles 1/4 inch to 3 1/2 inches in diameter; neutral; abrupt smooth boundary.

Bt1—16 to 26 inches; red (2.5YR 4/6) very gravelly clay, dark red (2.5YR 3/6) moist; weak fine angular blocky structure; extremely hard, firm; few fine roots; few distinct clay films on the surface of peds; 40 percent, by volume, siliceous pebbles 1/4 inch to 3 1/2 inches in diameter; slightly acid; gradual wavy boundary.

Bt2—26 to 48 inches; light yellowish brown (2.5Y 6/4) very gravelly clay, light olive brown (2.5Y 5/4) moist; weak fine angular blocky structure; extremely hard, firm; few distinct clay films on the surface of peds; 45 percent, by volume, siliceous pebbles 1/4 inch to 3 1/2 inches in diameter; slightly alkaline; gradual wavy boundary.

Bt3—48 to 55 inches; pale yellow (2.5Y 7/4) very gravelly clay, light yellowish brown (2.5Y 6/4) moist; weak medium angular blocky structure; extremely hard, firm; few distinct clay films on the surface of peds; about 35 percent, by volume, rounded siliceous pebbles 1/4 inch to 3 1/2 inches in diameter; slightly alkaline; clear smooth boundary.

2C—55 to 80 inches; pale yellow (2.5Y 7/4) very gravelly fine sand, light yellowish brown (2.5Y 6/4) moist; massive; 55 percent pebbles; few masses of calcium carbonate; slightly alkaline.

The solum ranges from 40 to 65 inches in thickness.

The A horizon is very dark grayish brown, grayish brown, dark brown, or brown. The E horizon is brown, light brownish gray, or pale brown. The texture of the E horizon ranges from gravelly loam to very gravelly fine sandy loam. Reaction is neutral or slightly acid in the A and E horizons. The content of siliceous pebbles ranges from 15 to 65 percent.

The Bt horizon is red, reddish brown, dark reddish brown, or dark brown. In the lower part it is mottled with light yellowish brown, light olive brown, or pale yellow. The content of gravel ranges from 35 to 80 percent, by volume. The texture ranges from clay to very gravelly clay. Reaction ranges from moderately acid to slightly alkaline.

The 2C horizon is very gravelly fine sand to very gravelly loamy sand. It has 45 to 90 percent coarse gravel. Some pedons are underlain by beds of sand and gravel and may contain cobble size fragments. Reaction ranges from neutral to moderately alkaline. Some pedons contain a few masses of calcium carbonate.

San Saba Series

The San Saba series consists of moderately deep, nearly level or gently sloping, moderately well drained, clayey soils on uplands. These soils formed in clayey marine sediments over indurated limestone of Lower Cretaceous age. Slopes range from 0 to 2 percent. Soils in the San Saba series are fine, montmorillonitic, thermic Leptic Udic Haplusterts.

Typical pedon of San Saba clay, 0 to 2 percent slopes; from the intersection of U.S. Highway 84 and Texas Highway 317 in McGregor, 3.0 miles west on U.S. Highway 84 to its intersection with Farm Road 938, and 50 feet north in an area of cropland:

Ap—0 to 4 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; weak fine and medium granular structure; very hard, very firm; few fine roots; slightly alkaline; abrupt smooth boundary.

A1—4 to 12 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; very hard, very firm; few fine roots; slightly alkaline; gradual wavy boundary.

A2—12 to 18 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; very hard, very firm; common pressure faces; common concretions of calcium carbonate; few quartz pebbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bkss—18 to 38 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine angular blocky structure; very hard, very firm; common prominent slickensides; common masses of calcium carbonate; violently effervescent; moderately alkaline; abrupt smooth boundary.

R—38 to 48 inches; coarsely fractured, indurated limestone with common fragments as much as 6 inches across.

The solum ranges from 24 to 40 inches in thickness. The texture of the soils is clay or silty clay. The content of clay ranges from 45 to 60 percent. When the soils are dry, cracks $^{1}/_{2}$ inch to $2^{1}/_{2}$ inches wide extend to a depth of 20 inches or more. Microdepressions and microknolls repeat at intervals of 10 to 20 feet. Reaction is slightly alkaline or moderately alkaline. Fragments of limestone make up as much as 5 percent of some pedons.

The A horizon is very dark gray, dark gray, or black. It is generally calcareous, although it is noncalcareous in some pedons in the center of microdepressions.

The Bkss horizon is dark gray, gray, dark grayish brown, or dark brown.

Sanger Series

The Sanger series consists of very deep, gently sloping, well drained, clayey soils on uplands (fig. 24). These soils formed in alkaline, clayey sediments of Lower Cretaceous age. Slopes range from 1 to 3 percent. Soils in the Sanger series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Sanger clay, 1 to 3 percent slopes; from the intersection of Texas Highway 317 and Farm Road 107 in Moody, 2.3 miles west on Farm Road 107, about 150 feet north of the road, in an area of cropland:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine angular blocky structure; extremely hard, very firm, very sticky and plastic; many fine and very fine roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A—6 to 34 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic; common fine roots; few prominent slickensides below a depth of 20 inches; slightly effervescent; moderately alkaline; diffuse wavy boundary.

Bkss1—34 to 61 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; few fine faint dark yellowish brown (10YR 3/4) mottles; weak coarse angular blocky structure; hard, firm, very sticky and plastic; common fine roots; common prominent slickensides; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bkss2—61 to 66 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; few fine faint olive yellow (2.5Y 6/6) mottles; weak coarse angular blocky structure; hard, firm, very sticky and plastic; few fine roots; common concretions of calcium carbonate; common prominent slickensides; strongly effervescent; moderately alkaline; gradual wavy boundary.

C—66 to 80 inches; yellow (10YR 7/6) shale with clay texture, brownish yellow (10YR 6/6) moist; common medium distinct light brownish gray (2.5Y 6/2) mottles; massive; extremely hard, very firm, very sticky and plastic; common masses of calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness. The texture is clay or silty clay throughout

the solum. The depth to slickensides is 16 to 25 inches. When the soils are dry, cracks 1 to 2 inches wide extend to a depth of 2 feet or more. In some microdepressions the upper 12 inches is noneffervescent.

The A horizon generally is very dark grayish brown, dark grayish brown, or grayish brown, but it is dark gray in some pedons in microdepressions.

The Bkss horizon is grayish brown, dark grayish brown, light yellowish brown, dark yellowish brown, yellowish brown, brownish yellow, or brown. It has few or common mottles in shades of gray or yellow. It has few to many concretions and masses of calcium carbonate.

The C horizon has colors in shades of brown, gray, or yellow and in some pedons is mottled with these colors. It is clay, clay loam, or shale. Some pedons are interbedded with weakly cemented marl or limestone.

Ships Series

The Ships series consists of very deep, nearly level, moderately well drained, clayey soils on flood plains along the Brazos River. These soils formed in stratified alluvial sediments. Slopes are 0 to 1 percent. Soils in the Ships series are very fine, mixed, thermic Chromic Hapluderts.

Typical pedon of Ships clay, rarely flooded; from the intersection of Texas Highway 6 and Farm Road 1860 about 5 miles east of Waco, 0.5 mile south on Farm Road 1860 to Missouri Pacific Railroad, 0.2 mile west to Wesley Robinson farm entrance, 0.5 mile southwest and 20 feet north in an area of cropland:

Ap—0 to 10 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/2) moist; weak fine angular blocky structure; very hard, firm; common fine and medium roots; common medium pores; slightly effervescent; moderately alkaline; clear smooth boundary.

A—10 to 24 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 4/3) moist; weak fine angular blocky structure; very hard, very firm; common fine and few medium roots; shiny pressure faces on some peds; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bkss1—24 to 60 inches; reddish brown (5YR 4/4) clay, reddish brown (5YR 4/3) moist; moderate fine angular blocky structure; very hard, very firm; few fine roots; common prominent slickensides; vertical cracks filled with darker soil from the horizon above; few masses of calcium carbonate; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bkss2—60 to 74 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate fine angular blocky structure; very hard, very firm; common prominent slickensides; common masses of calcium carbonate; few silty seams as much as 4 inches thick; strongly effervescent; moderately alkaline; clear wavy boundary.

2C—74 to 80 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; massive; firm, friable; violently effervescent; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. When the soils are dry, cracks $^1/_2$ inch to 2 inches wide extend to a depth of more than 2 feet. The content of clay in the A and Bk horizons is 60 to 70 percent. The soils are moderately alkaline and calcareous throughout.

The A horizon is dark brown, brown, reddish brown, or dark reddish brown clay.

The Bk horizon is reddish brown, red, dark reddish gray, yellowish red, or dark reddish brown.

The 2C horizon is reddish brown or dark reddish brown. It is dominantly clay or silty clay, but some pedons have thin strata of silt loam, silty clay loam, or loam below a depth of 60 inches.

Slidell Series

The Slidell series consists of very deep, nearly level or gently sloping, moderately well drained, clayey soils on uplands. These soils formed in clayey sediments over clayey marl stratified with indurated limestone of Lower Cretaceous age. Slopes range from 0 to 2 percent. Soils in the Slidell series are fine, montmorillonitic, thermic Udic Haplusterts.

Typical pedon of Slidell clay, 0 to 2 percent slopes; from the intersection of U.S. Highway 84 and Texas Highway 317 in McGregor, 1.8 miles west on U.S. Highway 84, and 0.2 mile north in an area of cropland:

Ap1—0 to 4 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and very fine subangular blocky structure; extremely hard, very firm, sticky and plastic; many fine roots and wormcasts; few fine siliceous pebbles; common fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Ap2—4 to 9 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; many fine roots and wormcasts; few fine siliceous pebbles;

common fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

A—9 to 20 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; many fine roots and wormcasts; few siliceous pebbles; few fine concretions of calcium carbonate; slightly effervescent; moderately alkaline; clear wavy boundary.

Bss—20 to 37 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots and wormcasts; many pressure faces; common prominent slickensides; few vertical streaks of yellowish brown (10YR 5/4) material; few siliceous pebbles; few concretions of calcium carbonate; few fine black concretions; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bkss1—37 to 43 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, sticky and plastic; few fine roots; common prominent slickensides; common masses of calcium carbonate; few dark concretions; strongly effervescent; moderately alkaline; clear wavy boundary.

Bkss2—43 to 72 inches; light gray (10YR 7/2) silty clay, light brownish gray (10YR 6/2) moist; few fine distinct strong brown (7.5YR 5/8) mottles; moderate fine and medium subangular blocky structure; extremely hard, very firm, sticky and plastic; few prominent slickensides; few pressure faces; few or common masses of calcium carbonate; few dark concretions; violently effervescent; moderately alkaline; clear irregular boundary.

BCk—72 to 74 inches; light brownish gray (2.5YR 6/2) silty clay interbedded with limestone fragments 2 to 3 inches thick.

The solum ranges from 60 to more than 80 inches in thickness. The texture of the soils is clay or silty clay. The content of clay is 45 to 60 percent. When the soils are dry, cracks $^1/_2$ inch to $2^1/_2$ inches wide extend to a depth of 20 inches or more. The depth to slickensides is 15 to 25 inches. In more than half of each pedon, the calcium carbonate equivalent is 40 to 60 percent in some part of the 10-to 40-inch control section. Microdepressions and microknolls repeat at intervals of 10 to 20 feet or more. The soils generally are effervescent and moderately alkaline, but in some microdepressions the upper 12 inches is noneffervescent and is slightly alkaline or moderately alkaline.

The A horizon is 15 to 45 inches thick. It is black, very dark brown, dark gray, or very dark gray.

The Bss and Bkss horizons are grayish brown, brown, pale brown, yellowish brown, or light yellowish brown. In some pedons the Bk horizon has yellowish and brownish mottles and has few or common films, threads, or masses of calcium carbonate.

The C horizon, where present, is grayish brown, brown, yellowish brown, pale brown, or light brownish gray. It is clay or silty clay. Some pedons have fractured limestone interbedded with marl below a depth of 70 inches.

Stephen Series

The Stephen series consists of very shallow or shallow, gently sloping or moderately sloping, well drained, clayey soils on uplands (fig. 25). These soils are underlain by chalky limestone that is interbedded with chalky marl and is of Upper Cretaceous age. Slopes range from 2 to 5 percent. Soils in the Stephen series are clayey, mixed, thermic, shallow Udorthentic Haplustolls.

Typical pedon of Stephen silty clay, in an area of Stephen-Eddy complex, 2 to 5 percent slopes; from the intersection of Farm Road 1695 and Farm Road 2837 in Lorena, 0.6 mile northwest on Farm Road 2837 to its intersection with a county road, 300 feet west and 100 feet north in an area of cropland:

Ap—0 to 8 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky and granular structure parting to very fine subangular blocky; hard, firm, sticky and plastic; many fine roots; few fine chalk fragments; violently effervescent; moderately alkaline; abrupt wavy boundary.

C/A—8 to 12 inches; about 65 percent platy chalk fragments and platy chalk in place and about 35 percent material that is dark brown (7.5YR 3/3) when moist; silty clay in the horizontal and vertical crevices and between the loose chalk fragments; few strongly cemented limestone cobbles; few fine roots; few fine pores; violently effervescent; moderately alkaline; abrupt irregular boundary.

Cr—12 to 28 inches; pink (5YR 8/3) and white (10YR 8/2), platy chalk that is 3 or less on the Mohs hardness scale; few thin tongues of dark brown, calcareous silty clay in crevices between some chalk plates.

The solum ranges from 7 to 20 inches in thickness.

When moist, the chalky limestone can be cut with a spade. The calcium carbonate equivalent ranges from 40 to 80 percent in the layer below the A horizon.

The A horizon is dark brown, grayish brown, dark gray, very dark grayish brown, or dark grayish brown. The content of chalk fragments ranges from a few to 35 percent, by volume.

Some pedons have a C horizon. The C and C/A horizons are interbedded chalk and limy material, soft limestone and marly material, or brownish clay loam, silty clay, or silty clay loam.

The Cr horizon is interbedded chalk and limy earth or soft limestone. The chalk is white and is interbedded with pink and gray limy earth.

Styx Series

The Styx series consists of very deep, gently sloping, well drained, sandy soils on high stream terraces of Pleistocene age. These soils formed in sandy and loamy alluvial sediments. Slopes range from 1 to 3 percent. Soils in the Styx series are loamy, siliceous, thermic Arenic Paleustalfs.

Typical pedon of Styx loamy fine sand, 1 to 3 percent slopes; from the intersection of Farm Road 1858 and Farm Road 933 in Gholson, 1.4 miles north on Farm Road 1858, about 0.2 mile west on a private road, and 100 feet south in an area of pasture:

Ap—0 to 8 inches; light yellowish brown (10YR 6/4) loamy fine sand, brown (10YR 4/3) moist; single grained; soft, loose; common fine and very fine roots; neutral; clear smooth boundary.

E—8 to 27 inches; very pale brown (10YR 8/4) loamy fine sand, pale brown (10YR 6/3) moist; single grained; soft, loose; few fine and medium roots; neutral; clear wavy boundary.

Bt1—27 to 30 inches; brownish yellow (10YR 6/6) and reddish yellow (7.5YR 6/8) sandy clay loam; moderate medium subangular blocky structure; very hard, friable; few fine roots; few distinct clay films on the surface of peds; moderately acid; gradual smooth boundary.

Bt2—30 to 45 inches; prominently mottled reddish yellow (7.5YR 6/8), red (2.5YR 4/6), and light gray (10YR 7/2) sandy clay loam; moderate medium subangular blocky structure; very hard, friable; few fine roots; few distinct clay films on the surface of peds; few uncoated sand grains; few strongly cemented red concretions; moderately acid; gradual smooth boundary.

Bt3—45 to 55 inches; prominently mottled red (2.5YR 4/6), reddish yellow (7.5YR 6/8), and light gray (10YR 7/2) sandy clay loam; moderate medium subangular blocky structure; very hard, friable; few fine roots; few distinct clay films on the surface of peds; few uncoated sand grains; few strongly cemented red concretions; moderately acid; gradual smooth boundary.

BCt—55 to 80 inches; distinctly mottled red (2.5YR 4/4), reddish yellow (5YR 6/6), and light gray (10YR 7/2) sandy clay loam; weak medium subangular blocky structure; very hard, friable; few distinct clay films on the surface of peds; few uncoated sand grains; strongly acid.

The solum ranges from 60 to more than 80 inches in thickness.

The A horizon ranges from 20 to 40 inches in thickness. It is light brownish gray, grayish brown, brown, light yellowish brown, or pale brown. Reaction ranges from strongly acid to neutral. The E horizon is very pale brown, light yellowish brown, or pale brown.

The upper part of the Bt horizon is pale brown, light yellowish brown, brownish yellow, yellow, or reddish yellow.

The lower part of the Bt horizon has strong brown, reddish brown, red, reddish yellow, light gray, or yellowish brown mottles. It is sandy clay loam or clay loam. The average content of clay in the upper 20 inches ranges from 25 to 35 percent. Reaction ranges from strongly acid to neutral.

The BCt horizon has red, strong brown, reddish brown, reddish yellow, or light gray mottles. Some pedons have bedding planes. Some pedons have a Bt/E horizon, which is mostly sandy clay loam with about 10 to 20 percent uncoated sand grains.

Sunev Series

The Sunev series consists of very deep, gently sloping, well drained, loamy soils on low terraces and in filled valleys of Pleistocene age (fig. 26). These soils formed in calcareous, loamy sediments along drainageways. Slopes range from 1 to 3 percent. Soils in the Sunev series are fine-loamy, carbonatic, thermic Udic Calciustolls.

Typical pedon of Sunev clay loam, 1 to 3 percent slopes; from the intersection of Texas Highway 6 and Farm Road 185 about 5.0 miles west of Waco, 0.6 mile north on Farm Road 185, about 1.8 miles west on a county road, and 0.3 mile south in an area of pasture.

A1—0 to 10 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky and granular structure; hard, firm; common fine and medium roots; about 10 percent limestone fragments about 1 inch in diameter; strongly effervescent; moderately alkaline; gradual smooth boundary.

A2—10 to 19 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; mixed with some dark brown material from the A1 horizon; few thin threads of calcium carbonate; about 10 percent limestone fragments about 1 inch in diameter; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk1—19 to 32 inches; pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; moderate medium subangular blocky structure; hard, firm; 10 percent limestone fragments about 1 inch in diameter; common fine masses of calcium carbonate; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk2—32 to 42 inches; very pale brown (10YR 7/4) loam, light yellowish brown (10YR 6/4) moist; moderate medium subangular blocky structure; hard, firm; 10 percent limestone fragments as much as 1 inch in diameter; common fine masses of calcium carbonate; violently effervescent; moderately alkaline; gradual smooth boundary.

BCk1—42 to 60 inches; very pale brown (10YR 8/4) clay loam, very pale brown (10YR 7/4) moist; moderate fine subangular blocky structure; hard, friable; common masses of calcium carbonate; violently effervescent; moderately alkaline; gradual smooth boundary.

BCk2—60 to 80 inches; very pale brown (10YR 8/4) clay loam, very pale brown (10YR 7/4) moist; weak fine subangular blocky structure; hard, friable; common masses of calcium carbonate; violently effervescent; moderately alkaline.

The solum ranges from 60 to 80 inches in thickness. The content of calcium carbonate is 40 to 60 percent. The solum is moderately alkaline and effervescent.

The A horizon is very dark grayish brown, dark grayish brown, dark brown, or brown clay loam.

The Bk horizon has colors in shades of brown or yellow. It is clay loam or loam. Limestone fragments are common. Most pedons have common thin threads of calcium carbonate and masses of calcium carbonate. The calcium carbonate equivalent is 40 to 70 percent.

The BCk horizon has colors in shades of brown or yellow. It is fine sandy loam, loam, sandy clay loam, or clay loam. Some pedons have weakly cemented limestone below a depth of 60 inches.

Tinn Series

The Tinn series consists of very deep, nearly level, moderately well drained, clayey soils on flood plains. These soils formed in calcareous, clayey alluvial sediments of Holocene age. Slopes are 0 to 1 percent. Soils in the Tinn series are fine, montmorillonitic, thermic Typic Hapluderts.

Typical pedon of Tinn clay, frequently flooded; from Farm Road 434 in Downsville, 2.6 miles south on Farm Road 434 to its intersection with a county road, 1.4 miles northeast on the county road, 0.3 mile north and 50 feet west of the road, in an area of cropland:

Ap—0 to 8 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate coarse angular blocky and granular structure; very hard, very firm, very sticky and very plastic; common fine and medium roots; few fine iron-manganese concretions; strongly effervescent; moderately alkaline; gradual smooth boundary.

A—8 to 16 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate coarse angular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; few fine pores; few thin strata of lighter and darker clayey sediments; few fine snail shell fragments; few fine iron-manganese concretions; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bss1—16 to 34 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate coarse angular blocky structure; very hard, very firm, very sticky and very plastic; common prominent slickensides and pressure faces; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bss2—34 to 55 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate coarse angular blocky structure; hard, very firm, very sticky and very plastic; few fine roots; few fine pores; common prominent slickensides and pressure faces; strongly effervescent; moderately alkaline; diffuse wavy boundary.

C—55 to 80 inches; light gray (10YR 7/2) clay, light brownish gray (10YR 6/2) moist; massive; very hard, very firm; common fine roots; prominent bedding planes; violently effervescent; moderately alkaline.

Slickensides are throughout the soils, mainly between depths of 20 and 60 inches. When the soils are dry, cracks $^{1}/_{2}$ inch to about 2 inches wide extend to a depth of more than 24 inches.

The A horizon is black, dark gray, or very dark gray. It is clay or silty clay. The content of clay ranges from 40 to 60 percent. Reaction is slightly alkaline or moderately alkaline.

The B horizon, if it occurs, is grayish brown, brown, or dark grayish brown. It is clay or silty clay.

The C horizon is very dark gray or light brownish gray. Some pedons have yellowish brown or olive yellow mottles. Some pedons have thin layers of sand and gravel below a depth of 60 inches.

Weswood Series

The Weswood series consists of very deep, nearly level, well drained, loamy soils on flood plains. These soils formed in stratified, calcareous, loamy Holocene-age alluvial sediments along the Brazos River. Slopes are 0 to 1 percent. Soils in the Weswood series are fine-silty, mixed, thermic Fluventic Ustochrepts.

Typical pedon of Weswood silt loam, rarely flooded; from Farm Road 434 in Downsville, 1.3 miles north, 1.8 miles east, and 50 feet south, in an area of cropland:

Ap—0 to 6 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; hard, friable, slightly sticky; common fine and medium roots; common medium pores; common wormcasts; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—6 to 18 inches; reddish brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; weak fine and medium granular and subangular blocky structure; hard, firm, slightly sticky; few fine roots; few fine pores; violently effervescent; moderately alkaline; clear smooth boundary.

Bw2—18 to 34 inches; yellowish red (5YR 6/4) silt loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; few fine pores; common wormcasts; few films and threads of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bw3—34 to 44 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, friable; few fine roots; few fine pores; few films and threads of calcium carbonate; 20 percent thin bedding planes; violently effervescent; moderately alkaline; clear smooth boundary.

C—44 to 80 inches; reddish yellow (5YR 7/6) silt loam, reddish yellow (5YR 6/6) moist; massive; slightly hard, friable; 40 percent thin bedding planes; common films and threads of calcium carbonate; violently effervescent; moderately alkaline.

The A horizon is reddish brown, brown, light brown, yellowish red, or light reddish brown.

The B horizon is reddish brown, light reddish brown, yellowish red, or reddish yellow. It is silt loam, clay loam, or silty clay loam. In most pedons some thin threads of calcium carbonate are between depths of 16 and 25 inches. They extend into the C horizon.

The C horizon is reddish brown, light reddish brown, light brown, reddish yellow, or pink. It is dominantly clay loam, silty clay loam, or silt loam, but in some pedons it has thin strata of very fine sandy loam, clay, or silty clay.

Wilson Series

The Wilson series consists of very deep, nearly level or gently sloping, moderately well drained, loamy soils on uplands. These soils formed in clayey sediments. Slopes range from 0 to 2 percent. Soils in the Wilson series are fine, montmorillonitic, thermic Oxyaquic Vertic Haplustalfs.

Typical pedon of Wilson clay loam, 0 to 2 percent slopes; from the intersection of Farm Road 1637 and Farm Road 3051 about 0.3 mile west of Bosqueville, 1.1 miles west on Farm Road 3434, about 0.2 mile north and 155 feet northeast of a fence:

A—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; very hard, firm; common fine and medium roots; common wormcasts and channels; few fine siliceous pebbles; neutral; clear wavy boundary.

Btg1—8 to 18 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium angular blocky structure; very hard, firm; common fine and medium roots; common wormcasts and channels; common distinct clay films; brown (10YR 5/3) sand grain coatings on peds and along root channels; few medium concretions of calcium carbonate; few coarse siliceous pebbles; neutral; gradual wavy boundary.

Btg2—18 to 32 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; very hard, firm; common very fine and fine roots; common fine and medium pores; common distinct clay films; brown (10YR 5/3) sand grain coatings on peds and along root channels; few coarse siliceous pebbles; neutral; gradual wavy boundary.

Btg3—32 to 47 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium and coarse angular blocky structure; very hard, firm; few very fine and fine roots; common distinct clay films; common fine concretions of calcium

carbonate; few coarse siliceous pebbles; neutral; gradual wavy boundary.

Btg4—47 to 65 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; few fine distinct strong brown (7.5YR 5/8) mottles; moderate medium and coarse angular blocky structure; extremely hard, firm; few very fine roots; many distinct clay films; common medium and coarse concretions of calcium carbonate; neutral; gradual wavy boundary.

Bk—65 to 80 inches; reddish yellow (7.5YR 6/6) clay, strong brown (7.5YR 5/6) moist; moderate medium angular blocky structure; hard, firm; few fine roots; few wormcasts and channels; few fine dark concretions; common medium concretions of calcium carbonate; few films and threads of calcium carbonate along root channels; strongly effervescent; moderately alkaline.

The solum is 60 inches or more thick. The content of clay in the control section ranges from 35 to 50 percent. When the soils are dry, cracks 1/2 inch or more wide form in the upper part of the subsoil and extend to a depth of 24 inches or more.

The A horizon is very dark grayish brown, dark gray, gray, dark grayish brown, or grayish brown. This horizon is less than 10 inches thick in more than 50 percent of the profile, but it is as much as 15 inches thick in subsoil troughs. The horizon is massive and hard or very hard when dry, but it has weak structure when moist. Some pedons have siliceous gravel. Reaction ranges from moderately acid to neutral.

The Btg1 horizon is very dark gray, dark gray, or black. It is clay or silty clay. Reaction ranges from moderately acid to slightly alkaline. The lower part of the Btg horizon is very dark gray, dark gray, grayish brown, brown, or light brownish gray. It is clay, clay loam, silty clay, or silty clay loam.

The Bk horizon, if it occurs, is strong brown, yellowish brown, or reddish yellow. It is clay, clay loam, or silty clay loam. Some pedons have olive, brownish, or yellowish mottles. Some pedons have few or common concretions of calcium carbonate. The content of siliceous pebbles ranges from 0 to about 15 percent, by volume.

Some pedons have a BC or BCk horizon, which has colors in shades of gray, brown, or olive and has mottles and strata of these colors. The BC or BCk horizon is silty clay, clay, clay loam, or shale. It has few or common concretions and masses of calcium carbonate. Some strata have siliceous pebbles.

Yahola Series

The Yahola series consists of very deep, nearly level or gently sloping, well drained, loamy soils on flood plains (fig. 27). These soils formed in loamy, calcareous Holocene-age alluvium along the Brazos River. Slopes range from 0 to 5 percent. Soils in the Yahola series are coarse-loamy, mixed (calcareous), thermic Udic Ustifluvents.

Typical pedon of Yahola very fine sandy loam, in an area of Yahola-Gaddy complex, occasionally flooded; from Farm Road 434 in Downsville, 1.7 miles east on a gravel road and 0.5 mile north in an area of rangeland:

A—0 to 10 inches; pale brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 5/4) moist; weak fine granular structure; slightly hard, very friable; many fine roots; strongly effervescent; moderately alkaline; gradual smooth boundary.

C1—10 to 26 inches; reddish yellow (7.5YR 6/6) very fine sandy loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable; few fine and medium roots; few wormcasts; violently effervescent; moderately alkaline; gradual smooth boundary.

C2—26 to 42 inches; reddish yellow (7.5YR 6/6) very fine sandy loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable; few thin strata of coarse sand; violently effervescent; moderately alkaline; gradual smooth boundary.

C3—42 to 65 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; common thin strata of coarse sand; violently effervescent; moderately alkaline.

The A horizon is brown, dark brown, pale brown, light brown, reddish yellow, or dark reddish gray. It is very fine sandy loam or loam. Reaction is slightly alkaline or moderately alkaline.

The C horizon is light reddish brown, reddish yellow, pink, light brown, reddish brown, strong brown, or yellowish red. It is very fine sandy loam, fine sandy loam, loam, or loamy fine sand and may have thin strata of coarse sand, silt loam, silty clay loam, or clay. Reaction is moderately alkaline.

Formation of the Soils

This section relates the factors of soil formation to the soils in McLennan County. It also describes the processes of horizon differentiation.

Factors of Soil Formation

Soil forms through processes that act on geologic material. The properties of the soil result from the kind of parent material and from additions, removals, transfers, and translocations caused by climate, plant and animal life, relief, and time. Also important are the cultural environment and patterns of land use.

The characteristics of a soil at any given point are determined by the physical and mineral composition of the parent material; the climate during and after accumulation of the parent material; the plant and animal life on and in the soil; relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material. All five of these factors are important in the formation of any soil, but the influence of each varies from place to place.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineral composition of the soil. The soils in McLennan County formed in several kinds of parent material ranging from Cretaceous to Recent in age *(23)*. The geologic formations include Comanche Peak Limestone, Edwards Limestone, Georgetown Limestone, Del Rio Clay, Buda Limestone, Pepper Shale, Lake Waco Shale, South Bosque Shale, Austin Chalk, Ozan Shale, Wolfe City Sand, and Pecan Gap Chalk. Also, some of the soils formed in sandy, loamy, or clayey sediments on Pleistocene-age terraces or in Recent alluvium. The various kinds of parent material are described in detail in the section “Surface Geology.”

Climate

McLennan County has a subhumid, warm, temperate climate. Winters are usually cool and short, but occasional surges of cold air can cause a sharp drop in temperature. Summers are long and have hot days and warm nights.

The climate contributes to the formation of soils in several ways. In winter cool temperatures, fog, drizzles, and light showers contribute to low soil temperatures, poor soil aeration, and a reduction in plant and animal activity in clayey, moderately well drained soils. In spring rains of short duration and high intensity retard soil formation because they result in erosion of the surface layer. Decomposition of organic matter continues most of the year, and much of the plant residue is decomposed each year. As a result, the dark surface layer of the soils is thinner than that of soils in cooler climates. During hot, dry summers the clay-textured soils, such as Houston Black, Heiden, Branyon, and Burleson soils, dry and then develop deep cracks. Shrinking and swelling churn the soils and prevent the development of a Bt horizon.

The amount of rainfall in the county is enough to leach calcium carbonate from the upper horizons of some soils, but it is not enough to leach out the carbonate entirely. Most of the soils in the county have films, threads, and nodules of calcium carbonate throughout the profile. When calcium carbonate is leached in a soil, water moving through the soil can carry clay particles downward from the surface layer and deposit them where water movement is slowed. As clay accumulates, the water moves at an even slower rate and the accumulation of clay accelerates. Axtell, Chazos, and Minwells are examples of soils in which calcium carbonate is leached and clay has accumulated in the subsoil.

Plant and Animal Life

Plants, animals, insects, bacteria, worms, and fungi are all important in the formation of soils. Gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in structure and porosity are caused by these living organisms.

Throughout most of the county, tall grasses have had more influence on soil formation than other plants. These grasses provided litter that protected the surface from erosion and added organic matter, which darkened the surface layer in Houston Black, Austin, Branyon, Slidell, and other soils. The grass roots reached deep into the soil and fed on nutrients and minerals at the lower depths. Carbonates, nutrients,

and organic matter were distributed throughout the soil profile as these plants died and were decomposed. The decomposed plant roots left channels and increased the rate of water intake and the aeration of the soil. Earthworms and other soil organisms fed on the decomposed roots. The boring of earthworms helped to channel water and air through the soil. Soils that formed under grassland vegetation and in alkaline parent material have more organic matter and a darker surface layer than soils that formed under trees. Axtell, Chazos, and Riesel are examples of soils in the central and eastern parts of the county that formed under woody vegetation and have a lighter colored surface layer with a low content of organic matter.

Human activities also have influenced soil formation. Indians burned the tall prairie grasses to herd buffalo. Later, European settlers imported cattle to graze the vegetation on the land. Most of the soils have been used for cultivated crops, so the native vegetation has been destroyed and some areas have eroded. Currently, most farmers plan to leave crop residue on the surface and install terraces and waterways to control erosion, but these measures have not always been applied.

Relief

Relief influences soil formation through its effect on drainage, runoff, and the depth of penetration by soil moisture. The relief in the county is nearly level to steep. The nearly level areas are mainly on bottomland and terraces throughout the county. Most of the county is gently sloping. The more sloping areas are along breaks to the major streams in the western part of the county.

If other factors are equal, the degree of soil profile development depends on the amount and depth of penetration by soil moisture. Steep soils absorb less moisture than gently sloping soils and generally have profiles that are more poorly developed. Heiden and Ferris soils formed in similar kinds of parent material. Generally, the Ferris soils are steeper than the Heiden soils, have a lighter colored surface layer, and are more eroded. Erosion has kept the surface layer of the Ferris soils thin and light colored. Heiden soils, in contrast, have a dark surface layer.

Houston Black, Branyon, and other soils on foot slopes and in nearly level areas receive additional moisture. They grow more vegetation than soils in most other positions and consequently contain more organic matter.

Time

Time, generally a long time, is required for the formation of soils that have distinct horizons. The length of time that the parent material has been in place is commonly reflected in the degree of profile development in the soils.

The soils in McLennan County range in age from young to old. The young Yahola and Gaddy soils on flood plains are characterized by little profile development. Except for a slight accumulation of organic matter and darkening of the surface layer, these soils retain evidence of stratification and other characteristics of their recent alluvial sediments.

The older Axtell and Chazos soils have distinct soil horizons that do not resemble the parent material. In these soils clay particles have moved downward in the soil profile, forming dense, clayey subsoil layers.

The clayey soils of the Texas Blackland Prairie areas, such as Houston Black, Heiden, and Sanger soils, are young in terms of horizon development, even though they are old chronologically. Thus, horizon development is not related only to the passage of time.

Processes of Horizon Differentiation

The formation of soil horizons is the result of several processes. Among these are the accumulation of organic matter, the leaching of carbonates and bases, the reduction and transfer of iron, and the translocation of silicate clay minerals. The formation of horizons in most of the soils in the county has been affected by more than one of these processes.

The soils in the county have a low to high content of organic matter. The accumulation of organic matter in the upper part of the profile is important in the formation of an A1 horizon. The organic matter darkens the surface layer. A dark surface layer that contains at least 1 percent organic matter and is at least 10 inches thick is called a mollic epipedon. Austin, Denton, and Krum are examples of soils that have a dark surface layer resulting from the accumulation of organic matter.

Carbonates have been leached in many of the soils in the county. The leaching of carbonates and bases generally precedes the translocation of silicate clay minerals. Much leaching has occurred in Bremond, Crockett, and Wilson soils. Lamar, Lewisville, and Lott soils have a surface layer that is high in content of carbonates.

Gleying, or the reduction and transfer of iron, is evident in the moderately drained soils in the county. Grayish colors below the surface layer indicate the reduction and loss of iron in Mabank soils. Yellowish brown, strong brown, and reddish brown concentrations indicate the segregation of iron in the subsoil of Chazos soils.

The translocation of clay minerals has contributed

to horizon development in many of the soils in the county. The Bt horizon generally has accumulations of clay (clay films) in pores and on the surface of peds. The soils probably were leached of carbonates and bases before the translocation of silicate clay. Bastsil and Minwells are examples of soils that have layers with accumulations of translocated clay.

Surface Geology

Dr. Joe C. Yelderman, Jr., geologist, Department of Geology, Baylor University, prepared this section.

The oldest rocks exposed in McLennan County were deposited during the Cretaceous Period, approximately 135 to 75 million years ago. At that time McLennan County was covered by a shallow sea that gradually deepened to the southeast. Sediments were deposited on the gently inclined sea bottom, resulting in layers of limestone and calcareous shale. As the sediments thickened, compaction occurred and eventually faulting took place along a hinge-line that parallels the ancient, buried Ouachita Mountains thousands of feet below. This faulting began in late Cretaceous to Miocene time (75 to 25 million years ago) and formed a northeast-southwest trend, known as the Balcones Fault Zone, that dissects the county. About 60 million years ago, the seas receded and erosion began exposing the layers of shale and limestone in parallel bands aligned from northeast to southwest through the county.

The softer shales were more easily eroded than the harder limestones, and as major streams settled into their courses (about 500,000 years ago), the Bosque River and Brazos River systems produced the major topographic features in the county—the Bosque Escarpment and the Brazos River Valley. The Bosque Escarpment is a ridge that parallels the Balcones Fault Zone and dissects the gentle prairies to the east and west. This escarpment has some of the steepest slopes in the county and is a continuation of the more extensive White Rock Escarpment to the north.

The Brazos River eroded through the escarpment, producing a broad flood plain of alluvial pebbles, sands, silts, and clays bordered by older terrace deposits. These alluvial units trend from northwest to southeast, almost perpendicular to the Bosque Escarpment and the Balcones Fault Zone. Most of the terraces are of Pleistocene age (2 million to 10,000 years ago), whereas the flood plain is of Holocene age (less than 10,000 years old). The other major streams also produced terraces and flood plains during this time, but the Brazos River is unique in its size and its sand content.

In the northwestern part of the county, the prairies give way to a cut-plain topography of wide valleys and flat-topped hills (mesas). This topography evolved because of the erosion-resistant Edwards Limestone, which caps the tops of the valley walls and small mesas. The result is the characteristic hill country of the Lampasas Cut Plain.

The major geologic features control soil formation in McLennan County by determining the parent material, topography, microclimate, organic activity, rate of weathering, and time of exposure that result in the present-day soils. Sandy soils are more common in areas of Brazos River alluvium; thick, clay-textured soils are more common on the shale prairies; and thin, rocky soils are more common on steep slopes underlain by limestone. The thicker soils generally are near faults in limestone or where weathering is deeper over the more fractured rocks. They also are in valleys, where alluvial and colluvial deposits add to the accumulation of soil material.

Following is a detailed account of the geologic formations and their related soils, described in order from oldest to youngest and from west to east across the county. The general soil map in this publication can be used to locate the outcrops described in this section.

Cretaceous System

Most of McLennan County is on formations of the Cretaceous System. The formations are described in the paragraphs that follow.

Fredericksburg Group. Only the upper two formations of the Fredericksburg Group crop out in McLennan County. These include Comanche Peak Limestone and Edwards Limestone. These limestones are in the extreme western part of the county, along the sides of stream valleys. The nodular Comanche Peak Limestone underlies the more massive, resistant Edwards Limestone, which protects the Comanche Peak Limestone from erosion.

Steep slopes are common, and the soils developed on the Fredricksburg Group generally are shallow and stony. Examples are Bolar, Denton, Eckrant, and Oglesby soils.

Washita Group. Overlying the Fredericksburg Group are rocks of the Washita Group, which include the Georgetown, Del Rio, and Buda Formations. The Georgetown Formation outcrop occupies an extensive part of western McLennan County. It can be divided into the Lower Georgetown Formation and the Upper Georgetown Formation. The entire Georgetown Formation consists of interbedded limestones and shales. The Lower Georgetown Formation contains more resistant limestone and forms slightly steeper

topography than the Upper Georgetown Formation. Denton, Aledo, Bolar, and Eckrant soils are common on the Lower Georgetown Formation. In contrast, Crawford and Purves soils are more common on the Upper Georgetown Formation, which contains a greater percentage of clay.

Overlying the Georgetown Formation is Del Rio Clay, which, although predominantly clay, has a few thin beds of calcareous siltstone and fossiliferous limestone flags. Del Rio Clay is easily eroded and forms a gentle topography with thick, clay-textured soils, such as Sanger, Slidell, and Lott soils.

The Buda Formation outcrop is insignificant in McLennan County, only occurring in a few isolated locations.

Woodbine Group. The Woodbine Group is represented in McLennan County by Pepper Shale, which crops out in a narrow band west of the White Rock Escarpment, near the base of the scarp. Pepper Shale is noncalcareous but commonly is covered with calcareous soils because of colluvial overwash from the Lake Waco Formation of the Eagle Ford Group. Heiden, Lott, McLennan, and Ellis soils are common on the Woodbine Group.

Eagle Ford Group. The Eagle Ford Group crops out in a narrow belt directly west of the White Rock Escarpment and makes up the west-facing slope. The group has two formations—the Lake Waco Formation and the overlying South Bosque Formation.

The Lake Waco Formation is shale that is discontinuously interbedded with limestone flags in its upper Bouldin Member and its lower Bluebonnet Member. The middle Cloice Member is predominantly bentonitic shale. The limestone flags protect the less resistant shale that forms a lower bench holding up the hills between Spring Valley and Moody, in western McLennan County. The South Bosque Formation is predominantly calcareous shale with a few interbedded limestone flags at the base and less calcareous shale near the top.

The Eagle Ford Group has an abundance of clay. The clayey Heiden, Lott, Houston Black, and Ferris soils are common in areas of this group.

Austin Chalk. Austin Chalk in McLennan County caps the west-facing cuesta of the White Rock Escarpment, which is most pronounced along the Bosque River System and is known locally as the Bosque Escarpment. The outcrop of Austin Chalk parallels the center of the Balcones Fault Zone, where the rocks are faulted and highly fractured. Austin Chalk is a sequence of interbedded chalk and marl beautifully exposed in bluffs along the Bosque River (Lovers Leap in Cameron Park) and along the Brazos River through Waco.

Topography in areas of Austin Chalk ranges from steep scarplands to gently rolling hills. Along the scarp, near bluffs, and in other areas where the topography is steep, the soils are thin. Examples are Stephen and Eddy soils. On the more gentle topography to the east, Austin Chalk is overlain by thicker soils, including Austin, Fairlie, Heiden, and Houston Black soils.

Taylor Group. The entire eastern part of the county is underlain by rocks of the Taylor Group. From west to east and from oldest to youngest, these include the Ozan Formation, the Wolfe City Formation, and Pecan Gap Chalk. The lower two units, the Ozan and Wolfe City Formations, occupy parallel bands of near equal width east of the Austin Chalk. The overlying Pecan Gap Chalk occurs only near the town of Mart. The Ozan Formation is a blocky, blue gray shale that weathers to light tan. It is overlain by the very similar Wolfe City Formation, which has a few thin sand lenses less than 1 inch thick. Pecan Gap Chalk, which is blocky, white chalky marl, overlies the Wolfe City Formation.

All of the rocks in the Taylor Group are easily eroded, and the resulting topography consists of gently rolling hills with thick, dark soils. The rocks are a major part of the Texas Blackland Prairie, which is dominated by Houston Black, Heiden, Ferris, Burleson, Branyon, and Wilson soils.

Quaternary Period

Pleistocene- and Holocene-age alluvial deposits are along all of the streams of significant size in McLennan County. Pleistocene-age fluvial sediments and terraces, remnants of older flood plains, are generally older, with greater distances and higher elevations relative to the stream valleys. The younger, lower terraces along the Brazos River are dominated by Bastsil, Desan, and Gholson soils. The older, higher terraces are dominated by Axtell, Riesel, and Minwells soils. An unusual aspect of the higher terraces is their wide distribution in McLennan County, particularly east of the Brazos River. Other soils in areas of fluvial deposits include Chazos, Desan, Styx, Gowen, Bremond, Branyon, Wilson, and Burleson soils.

There are several large clayey terraces of unknown age in the county. The major soils on these terraces are those of the Branyon and Burleson series. Examples of these terraces are west of Lake Waco and in a flat area in the vicinity of Leroy.

Flood-plain deposits of Holocene age are directly adjacent to stream channels and occupy the present stream valleys. These deposits consist of

unconsolidated gravel, sand, silt, and clay with significant amounts of organic matter. The soils that formed in these deposits are immature and susceptible to flooding. The flood plain along the Brazos River is dominated by Yahola, Gaddy, Weswood, and Ships soils. Frio or Bosque soils are generally on the flood plains along streams in the Grand Prairie area west of the Bosque Escarpment. The flood plains along streams in the eastern half of the county are dominated by Tinn and Ovan soils.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bottomland. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium

carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds directly beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing

consistence are defined in the “Soil Survey Manual.”

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Cuesta. A hill or ridge that has a gentle slope on one side and a steep slope on the other; specifically, an asymmetric, homoclinal ridge capped by resistant rock layers of slight or moderate dip.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the “Soil Survey Manual.”

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salt (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main

feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of

organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands,

savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are

many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular),

and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth’s surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

Table 1.--Temperature and Precipitation

(Recorded in the period 1951-86 at McGregor, Texas)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	55.0	32.1	43.6	82	11	58	1.90	0.54	2.99	4	0.6
February----	60.4	36.3	48.4	84	17	93	2.36	.98	3.52	4	.4
March-------	69.0	45.0	57.0	88	24	264	2.32	.69	3.64	4	.0
April-------	77.5	54.9	66.2	93	34	486	3.44	1.30	5.21	5	.0
May---------	84.0	62.1	73.1	96	44	716	4.60	2.52	6.43	6	.0
June--------	91.3	69.1	80.2	101	54	906	3.24	.70	5.21	4	.0
July--------	96.4	72.5	84.5	105	63	1,070	2.12	.16	3.51	3	.0
August------	96.1	71.8	84.0	106	61	1,054	2.01	.40	3.27	3	.0
September---	88.6	66.1	77.4	101	46	822	3.23	.95	5.08	4	.0
October-----	79.4	55.4	67.4	94	37	539	3.57	.94	5.68	4	.0
November----	67.8	44.9	56.4	86	25	224	2.49	.87	3.82	4	.0
December----	58.7	36.3	47.5	80	17	86	2.12	.77	3.24	4	.1
Yearly:											
Average---	77.0	53.9	65.5	---	---	---	---	---	---	---	---
Extreme---	---	---	---	107	9	---	---	---	---	---	---
Total-----	---	---	---	---	---	6,318	33.40	25.26	41.02	49	1.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1951-86 at McGregor, Texas)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Mar. 8	Mar. 20	Apr. 1
2 years in 10 later than--	Mar. 1	Mar. 13	Mar. 26
5 years in 10 later than--	Feb. 14	Feb. 27	Mar. 15
First freezing temperature in fall:			
1 year in 10 earlier than--	Nov. 28	Nov. 16	Nov. 2
2 years in 10 earlier than--	Dec. 4	Nov. 23	Nov. 9
5 years in 10 earlier than--	Dec. 17	Dec. 7	Nov. 22

Table 3.--Growing Season

(Recorded in the period 1951-86 at McGregor, Texas)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	281	256	226
8 years in 10	288	265	235
5 years in 10	303	282	251
2 years in 10	320	299	267
1 year in 10	>365	308	276

Table 4.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
AdC	Aledo gravelly clay loam, 2 to 5 percent slopes	34,056	5.1
AdE	Aledo-Brackett complex, 5 to 20 percent slopes	5,027	0.7
AsB	Austin silty clay, 1 to 3 percent slopes	8,031	1.2
AuC	Austin-Urban land complex, 1 to 3 percent slopes	4,905	0.7
AxB	Axtell fine sandy loam, 1 to 3 percent slopes	19,311	2.8
BaA	Bastsil fine sandy loam, 0 to 2 percent slopes	6,560	1.0
BaB	Bastsil-Urban land complex, 0 to 2 percent slopes	1,732	0.3
BgB	Bolar gravelly clay loam, 1 to 3 percent slopes	14,192	2.1
Bh	Bosque clay loam, occasionally flooded	2,652	0.4
BnA	Branyon clay, 0 to 1 percent slopes	22,715	3.3
BnB	Branyon clay, 1 to 3 percent slopes	2,376	0.3
BrB	Bremond loam, 0 to 2 percent slopes	5,426	0.8
BuA	Burleson clay, 0 to 1 percent slopes	12,384	1.8
CaB	Chazos loamy fine sand, 1 to 3 percent slopes	2,223	0.3
CfB	Crawford clay, 0 to 2 percent slopes	25,274	3.7
CrB	Crockett loam, 3 to 5 percent slopes	3,188	0.5
DeB	Denton silty clay, 1 to 3 percent slopes	13,687	2.0
DsC	Desan loamy fine sand, 1 to 5 percent slopes	2,299	0.3
DuB	Dutek loamy fine sand, 1 to 3 percent slopes	874	0.1
EcB	Eckrant cobbly silty clay, 1 to 3 percent slopes	6,575	1.0
EdD	Eddy gravelly clay loam, 3 to 15 percent slopes	8,384	1.2
EeD	Eddy-Urban land complex, 3 to 15 percent slopes	2,974	0.4
EsE	Ellis clay, 8 to 20 percent slopes	1,257	0.2
FaB	Fairlie clay, 1 to 3 percent slopes	12,154	1.8
FbB	Fairlie-Urban land complex, 1 to 3 percent slopes	4,047	0.6
FeE2	Ferris clay, 8 to 15 percent slopes, eroded	7,142	1.1
Fr	Frio silty clay, occasionally flooded	12,491	1.8
Ga	Gaddy loamy fine sand, frequently flooded	368	0.1
GhD	Gholson fine sandy loam, 3 to 8 percent slopes	1,319	0.2
Go	Gowen clay loam, frequently flooded	5,717	0.8
HeB	Heiden clay, 1 to 3 percent slopes	38,545	5.8
HeC	Heiden clay, 3 to 5 percent slopes	7,602	1.1
HeD	Heiden clay, 5 to 8 percent slopes	15,020	2.2
HgB	Heiden gravelly clay, 1 to 3 percent slopes	3,127	0.5
HoB	Houston Black clay, 1 to 3 percent slopes	39,694	5.8
KrC	Krum silty clay, 2 to 5 percent slopes	2,269	0.3
LaD	Lamar clay loam, 3 to 8 percent slopes	8,859	1.3
LeB	Lewisville silty clay, 1 to 3 percent slopes	13,150	1.9
LoB	Lott silty clay, 1 to 5 percent slopes	11,188	1.6
LoD	Lott silty clay, 5 to 8 percent slopes	18,438	2.7
MaA	Mabank fine sandy loam, 0 to 1 percent slopes	1,840	0.3
MbA	Mabank-Bremond complex, 0 to 1 percent slopes	6,529	1.0
McE	McLennan clay loam, 8 to 15 percent slopes	12,292	1.8
MnB	Minwells fine sandy loam, 1 to 3 percent slopes	4,276	0.6
MnC2	Minwells fine sandy loam, 3 to 5 percent slopes, eroded	2,637	0.4
OgB	Oglesby silty clay, 1 to 3 percent slopes	1,165	0.2
Ov	Ovan silty clay, frequently flooded	10,070	1.5
PcB	Payne clay loam, 1 to 3 percent slopes	5,656	0.8
Pg	Pits, gravel	4,414	0.6
Pr	Pits, quarry	583	0.1
PvB	Purves clay, 1 to 3 percent slopes	18,836	2.8
QuC	Queeny clay loam, 1 to 5 percent slopes	3,250	0.5
ReF	Real-Rock outcrop complex, 10 to 30 percent slopes	2,407	0.4
RgB	Riesel gravelly fine sandy loam, 1 to 3 percent slopes	7,510	1.1
SaB	San Saba clay, 0 to 2 percent slopes	1,472	0.2
SgB	Sanger clay, 1 to 3 percent slopes	8,445	1.2
Sh	Ships clay, rarely flooded	5,640	0.8
SsB	Slidell clay, 0 to 2 percent slopes	31,711	4.8
StC	Stephen-Eddy complex, 2 to 5 percent slopes	20,768	3.1
SuD	Stephen-Urban land complex, 2 to 5 percent slopes	3,127	0.5
SyB	Styx loamy fine sand, 1 to 3 percent slopes	874	0.1
SzB	Sunev clay loam, 1 to 3 percent slopes	4,031	0.6
Tn	Tinn clay, rarely flooded	1,855	0.3
To	Tinn clay, frequently flooded	25,335	3.7

Table 4.--Acreage and Proportionate Extent of the Soils--Continued

Map symbol	Soil name	Acres	Percent
Ur	Urban land	4,200	0.6
Wd	Weswood silt loam, rarely flooded	8,951	1.3
We	Weswood silty clay loam, rarely flooded	3,924	0.6
WnA	Wilson clay loam, 0 to 2 percent slopes	41,673	6.1
Ya	Yahola loam, rarely flooded	4,276	0.6
Yg	Yahola-Gaddy complex, occasionally flooded	4,598	0.7
	Water areas greater than 40 acres in size	19,585	2.9
	Total	679,162	100.0

Table 5.--Land Capability and Yields per Acre of Crops and Pasture

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Wheat	Corn	Grain sorghum	Cotton	Improved bermudagrass
		Bu	Bu	Bu	Lbs	AUM*
AdC Aledo	VIs	---	---	---	---	---
AdE**:						
Aledo	VIIs	---	---	---	---	---
Brackett	VIIs	---	---	---	---	---
AsB Austin	IIIe	40	80	75	350	6.5
AuC**: Austin-Urban land.						
AxB Axtell	IIIe	35	50	40	250	5.0
BaA Bastsil	IIe	45	80	80	350	7.0
BaB**: Bastsil-Urban land.						
BgB Bolar	IIIe	35	45	45	300	5.0
Bh Bosque	IIw	45	65	65	450	8.0
BnA Branyon	IIw	50	100	100	550	8.0
BnB Branyon	IIe	50	100	90	550	7.5
BrB Bremond	IIIe	40	70	70	350	6.0
BuA Burleson	IIw	40	85	95	600	7.0
CaB Chazos	IIe	20	55	45	---	7.0
CfB Crawford	IIe	40	60	75	350	6.0
CrB Crockett	IVe	20	50	45	200	5.5
DeB Denton	IIe	40	60	75	400	7.0
DsC Desan	IIIe	---	---	---	---	6.0

See footnotes at end of table.

Table 5.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Wheat	Corn	Grain sorghum	Cotton	Improved bermudagrass
		Bu	Bu	Bu	Lbs	AUM*
DuB----------------------- Dutek	IIIs	---	---	40	---	7.0
EcB----------------------- Eckrant	VIIs	---	---	---	---	---
EdD----------------------- Eddy	VIe	---	---	---	---	---
EeD**: Eddy-Urban land.						
EsE----------------------- Ellis	VIe	---	---	---	---	3.5
FaB----------------------- Fairlie	IIe	40	90	90	500	6.0
FbB**: Fairlie-Urban land.						
FeE2---------------------- Ferris	VIe	---	---	---	---	4.0
Fr------------------------ Frio	IIw	40	90	90	450	8.0
Ga------------------------ Gaddy	Vw	---	---	---	---	4.0
GhD----------------------- Gholson	IVe	30	55	55	300	6.0
Go------------------------ Gowen	Vw	---	---	---	---	7.0
HeB----------------------- Heiden	IIe	45	90	90	450	7.0
HeC----------------------- Heiden	IIIe	40	75	75	350	6.0
HeD----------------------- Heiden	IVe	30	50	50	300	4.0
HgB----------------------- Heiden	IIe	35	70	70	350	7.0
HoB----------------------- Houston Black	IIe	45	100	100	550	7.0
KrC----------------------- Krum	IIIe	35	65	65	350	6.5
LaD----------------------- Lamar	IVe	20	35	40	---	4.5
LeB----------------------- Lewisville	IIe	40	80	80	500	7.5

See footnotes at end of table.

Table 5.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Wheat	Corn	Grain sorghum	Cotton	Improved bermudagrass
		Bu	Bu	Bu	Lbs	AUM*
LoB----------------------- Lott	IIIe	40	80	80	350	6.5
LoD----------------------- Lott	IVe	30	60	70	350	5.5
MaA----------------------- Mabank	IIIw	30	55	55	330	6.0
MbA**:						
Mabank-------------------	IIIw	30	55	55	330	6.0
Bremond------------------	IIw	40	70	70	400	6.0
McE----------------------- McLennan	VIe	---	---	---	---	2.0
MnB----------------------- Minwells	IIe	20	40	45	300	6.0
MnC2---------------------- Minwells	IIIe	20	30	30	---	4.0
OgB----------------------- Oglesby	IVs	30	---	---	---	3.0
Ov------------------------ Ovan	Vw	---	---	---	---	8.0
PcB----------------------- Payne	IIIe	30	50	55	300	6.0
Pg**, Pr**---------------- Pits	VIIIs	---	---	---	---	---
PvB----------------------- Purves	IVs	30	---	35	---	4.0
QuC----------------------- Queeny	IVs	---	---	25	---	3.0
ReF**:						
Real---------------------	VIIs	---	---	---	---	---
Rock outcrop-------------	VIIIs	---	---	---	---	---
RgB----------------------- Riesel	VIs	---	---	---	---	3.5
SaB----------------------- San Saba	IIIe	40	75	75	350	6.0
SgB----------------------- Sanger	IIe	45	80	80	350	6.5
Sh------------------------ Ships	IIs	40	110	100	750	6.0
SsB----------------------- Slidell	IIe	45	85	85	350	7.0

See footnotes at end of table.

Table 5.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Wheat	Corn	Grain sorghum	Cotton	Improved bermudagrass
		Bu	Bu	Bu	Lbs	AUM*
StC**:						
Stephen	IVe	20	---	45	150	3.5
Eddy	VIe	20	---	---	---	---
SuD**: Stephen-Urban land.						
SyB Styx	IIIe	20	65	65	300	7.5
SzB Sunev	IIe	35	45	55	250	5.0
Tn Tinn	IIw	35	90	90	500	8.0
To Tinn	Vw	---	---	---	---	8.0
Ur**. Urban land						
Wd, We Weswood	I	45	120	100	900	8.0
WnA Wilson	IIIw	30	50	50	300	6.0
Ya Yahola	IIe	35	80	70	600	8.0
Yg**:						
Yahola	IIw	35	80	70	600	8.0
Gaddy	IVs	15	---	30	---	4.0

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

Table 6.--Rangeland Productivity

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
AdC: Aledo	Shallow	3,000	2,000	1,800
AdE*:				
Aledo	Shallow	2,800	2,000	1,400
Brackett	Steep Adobe	3,000	2,200	1,500
AsB: Austin	Clay Loam	6,500	5,000	3,000
AxB: Axtell	Claypan Savannah	5,000	3,500	2,500
BaA: Bastsil	Sandy Loam	6,500	5,000	3,500
BgB: Bolar	Clay Loam	6,500	5,000	3,000
Bh: Bosque	Loamy Bottomland	6,500	5,000	3,500
BnA, BnB: Branyon	Blackland	7,000	5,500	3,500
BrB: Bremond	Claypan Prairie	5,000	4,500	2,500
BuA: Burleson	Blackland	7,000	5,500	4,000
CaB: Chazos	Sandy Loam	5,500	4,500	3,000
CfB: Crawford	Deep Redland	6,000	5,000	3,500
CrB: Crockett	Claypan Prairie	6,000	5,000	3,000
DeB: Denton	Clay Loam	6,500	5,000	3,000
DsC: Desan	Deep Sand	3,000	2,000	1,000
DuB: Dutek	Sandy	4,500	4,000	2,000
EcB: Eckrant	Low Stony Hill	3,000	2,500	1,500
EdD: Eddy	Chalky Ridge	4,500	3,500	2,000
EsE: Ellis	Eroded Blackland	4,500	3,500	2,000

See footnote at end of table.

Table 6.--Rangeland Productivity--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
FaB: Fairlie	Blackland	7,000	6,000	3,500
FeE2: Ferris	Eroded Blackland	4,500	3,500	2,000
Fr: Frio	Loamy Bottomland	7,000	5,000	4,000
Ga: Gaddy	Sandy Bottomland	3,800	2,700	2,000
GhD: Gholson	Sandy Loam	5,500	4,500	3,000
Go: Gowen	Loamy Bottomland	7,000	5,500	4,000
HeB, HeC, HeD, HgB: Heiden	Blackland	7,000	6,000	3,500
HoB: Houston Black	Blackland	7,000	6,000	3,500
KrC: Krum	Clay Loam	6,500	6,000	4,000
LaD: Lamar	Clay Loam	6,000	4,500	3,000
LeB: Lewisville	Clay Loam	6,500	5,500	3,000
LoB, LoD: Lott	Clay Loam	6,500	5,000	3,000
MaA: Mabank	Claypan Prairie	6,000	5,000	3,000
MbA*:				
Mabank	Claypan Prairie	6,000	5,000	3,000
Bremond	Claypan Prairie	5,000	4,500	2,500
McE: McLennan	Eroded Blackland	5,000	4,000	3,000
MnB, MnC2: Minwells	Sandy Loam	5,000	3,500	2,500
OgB: Oglesby	Shallow Clay	5,000	4,500	2,500
Ov: Ovan	Clayey Bottomland	7,500	6,000	4,000
PcB: Payne	Claypan Prairie	6,000	5,000	3,000
PvB: Purves	Shallow	3,000	2,500	1,800

See footnote at end of table.

Table 6.--Rangeland Productivity--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
QuC: Queeny	Chalky Ridge	4,000	3,000	1,800
ReF*:				
Real	Steep Adobe	3,000	2,200	1,500
Rock outcrop.				
RgB: Riesel	Gravelly	4,500	3,500	2,000
SaB: San Saba	Blackland	6,000	5,000	3,500
SgB: Sanger	Blackland	6,000	5,000	3,000
Sh: Ships	Clayey Bottomland	7,500	6,000	4,500
SsB: Slidell	Blackland	6,000	5,000	3,000
StC*:				
Stephen-Eddy	Chalky Ridge	4,500	3,500	2,000
SyB: Styx	Sandy	5,500	4,500	3,000
SzB: Sunev	Clay Loam	7,000	5,500	3,500
Tn, To: Tinn	Clayey Bottomland	7,000	6,000	4,000
Wd, We: Weswood	Loamy Bottomland	8,000	6,500	5,000
WnA: Wilson	Claypan Prairie	6,000	5,000	3,000
Ya: Yahola	Loamy Bottomland	7,500	5,500	4,000
Yg*:				
Yahola	Loamy Bottomland	7,500	5,500	4,000
Gaddy	Sandy Bottomland	3,800	2,700	2,000

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 7.--Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AdC: Aledo	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight	Severe: depth to rock.
AdE*:					
Aledo	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: depth to rock.
Brackett	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, droughty, slope.
AsB: Austin	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
AuC*:					
Austin	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
Urban land	Variable	Variable	Variable	Variable	Variable.
AxB: Axtell	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.	Moderate: droughty.
BaA: Bastsil	Slight	Slight	Slight	Slight	Slight.
BaB*:					
Bastsil	Slight	Slight	Slight	Slight	Slight.
Urban land	Variable	Variable	Variable	Variable	Variable.
BgB: Bolar	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, large stones, thin layer.
Bh: Bosque	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
BnA: Branyon	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
BnB: Branyon	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
BrB: Bremond	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight.

See footnote at end of table.

Table 7.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
BuA: Burleson	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
CaB: Chazos	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
CfB: Crawford	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: small stones, too clayey.	Moderate: too clayey.	Severe: too clayey.
CrB: Crockett	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Severe: erodes easily.	Moderate: droughty.
DeB: Denton	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
DsC: Desan	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
DuB: Dutek	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
EcB: Eckrant	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, small stones, depth to rock.	Moderate: large stones.	Severe: depth to rock, low strength.
EdD: Eddy	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: small stones, thin layer.
EeD*:					
Eddy	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Slight	Severe: small stones, thin layer.
Urban land	Variable	Variable	Variable	Variable	Variable.
EsE: Ellis	Moderate: slope, percs slowly, too clayey.	Moderate: slope, too clayey, percs slowly.	Severe: slope.	Moderate: too clayey.	Severe: too clayey.
FaB: Fairlie	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
FbB*:					
Fairlie	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.

See footnote at end of table.

Table 7.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
FbB*:					
Urban land	Variable	Variable	Variable	Variable	Variable.
FeE2 Ferris	Moderate: slope, percs slowly.	Moderate: slope, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
Fr Frio	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
Ga Gaddy	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
GhD Gholson	Slight	Slight	Moderate: slope.	Slight	Slight.
Go Gowen	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
HeB, HeC Heiden	Moderate: percs slowly.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
HeD Heiden	Moderate: percs slowly.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.	Severe: too clayey.
HgB Heiden	Moderate: small stones, percs slowly.	Moderate: too clayey, small stones.	Severe: small stones.	Severe: small stones.	Severe: too clayey.
HoB Houston Black	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
KrC Krum	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope.	Moderate: too clayey.	Severe: too clayey.
LaD Lamar	Slight	Slight	Moderate: slope.	Slight	Slight.
LeB Lewisville	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
LoB Lott	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
LoD Lott	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.	Severe: too clayey.
MaA Mabank	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Moderate: droughty.
MbA*:					
Mabank	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Moderate: droughty.
Bremond	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Slight.

See footnote at end of table.

Table 7.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
McE: McLennan	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: large stones, slope.
MnB, MnC2: Minwells	Slight	Slight	Moderate: slope.	Slight	Slight.
OgB: Oglesby	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.	Severe: depth to rock, too clayey.
Ov: Ovan	Severe: flooding.	Moderate: flooding, too clayey, percs slowly.	Severe: flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.
PcB: Payne	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight	Slight.
Pg*, Pr*. Pits					
PvB: Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.	Severe: depth to rock, too clayey.
QuC: Queeny	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight	Severe: cemented pan.
ReF*:					
Real	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.	Severe: slope, depth to rock.
Rock outcrop.					
RgB: Riesel	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones, droughty.
SaB: San Saba	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
SgB: Sanger	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
Sh: Ships	Severe: flooding, percs slowly, too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
SsB: Slidell	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.

See footnote at end of table.

Table 7.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
StC*:					
Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.	Severe: thin layer, too clayey.
Eddy	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Slight	Severe: small stones, thin layer.
SuD*:					
Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.	Severe: thin layer, too clayey.
Urban land	Variable	Variable	Variable	Variable	Variable.
SyB Styx	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: droughty.
SzB Sunev	Slight	Slight	Moderate: slope.	Slight	Slight.
Tn Tinn	Severe: flooding.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
To Tinn	Severe: flooding.	Moderate: flooding, too clayey, percs slowly.	Severe: flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.
Ur* Urban land	Variable	Variable	Variable	Variable	Variable.
Wd, We Weswood	Severe: flooding.	Slight	Slight	Slight	Slight.
WnA Wilson	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight	Moderate; droughty.
Ya Yahola	Severe: flooding.	Slight	Slight	Slight	Slight.
Yg*:					
Yahola	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
Gaddy	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Moderate: flooding.	Moderate: droughty, flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 8.--Wildlife Habitat

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
AdC---------------- Aledo	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
AdE*:									
Aledo-------------	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
Brackett----------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Very poor	Very poor	Fair.
AsB---------------- Austin	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
AuC*:									
Austin------------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Urban land.									
AxB---------------- Axtell	Fair	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Good.
BaA---------------- Bastsil	Good	Fair	Good	Good	Poor	Very poor	Good	Very poor	Good.
BaB*:									
Bastsil-----------	Good	Fair	Good	Good	Poor	Very poor	Good	Very poor	Good.
Urban land.									
BgB---------------- Bolar	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Bh----------------- Bosque	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
BnA, BnB----------- Branyon	Good	Good	Poor	Fair	Poor	Poor	Fair	Poor	Fair.
BrB---------------- Bremond	Fair	Good	Good	Good	Poor	Poor	Good	Poor	Good.
BuA---------------- Burleson	Good	Good	Poor	Poor	Very poor	Very poor	Fair	Very poor	Poor.
CaB---------------- Chazos	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
CfB---------------- Crawford	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
CrB---------------- Crockett	Fair	Good	Good	Good	Poor	Poor	Good	Poor	Good.
DeB---------------- Denton	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.
DsC---------------- Desan	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

Table 8.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
DuB---------------- Dutek	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
EcB---------------- Eckrant	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
EdD---------------- Eddy	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
EeD*:									
Eddy--------------	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
Urban land.									
EsE---------------- Ellis	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
FaB---------------- Fairlie	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Fair.
FbB*:									
Fairlie-----------	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Fair.
Urban land.									
FeE2--------------- Ferris	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Fr----------------- Frio	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
Ga----------------- Gaddy	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
GhD---------------- Gholson	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Go----------------- Gowen	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
HeB---------------- Heiden	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
HeC, HeD----------- Heiden	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
HgB---------------- Heiden	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
HoB---------------- Houston Black	Good	Good	Poor	Fair	Poor	Poor	Fair	Poor	Fair.
KrC---------------- Krum	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
LaD---------------- Lamar	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
LeB---------------- Lewisville	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

Table 8.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
LoB, LoD: Lott	Fair	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
MaA: Mabank	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
MbA*:									
Mabank	Fair	Good	Good	Fair	Fair	Fair	Good	Fair	Fair.
Bremond	Fair	Good	Good	Good	Poor	Poor	Good	Poor	Good.
McE: McLennan	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
MnB: Minwells	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
MnC2: Minwells	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
OgB: Oglesby	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
Ov: Ovan	Poor	Poor	Fair	Fair	Poor	Good	Poor	Fair	Poor.
PcB: Payne	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
Pg*, Pr*. Pits									
PvB: Purves	Fair	Good	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
QuC: Queeny	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
ReF*:									
Real	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop.									
RgB: Riesel	Poor	Poor	Good	Good	Poor	Very poor	Fair	Very poor	Good.
SaB: San Saba	Fair	Fair	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
SgB: Sanger	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Sh: Ships	Good	Good	Fair	Fair	Fair	Poor	Good	Fair	Fair.
SsB: Slidell	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
StC*:									
Stephen	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

Table 8.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
StC*:									
Eddy	Poor	Poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
SuD*:									
Stephen	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Urban land.									
SyB Styx	Fair	Fair	Good	Good	Poor	Very poor	Fair	Very poor	Good.
SzB Sunev	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Tn Tinn	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor.
To Tinn	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Poor.
Ur*. Urban land									
Wd, We Weswood	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
WnA Wilson	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair.
Ya Yahola	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Yg*:									
Yahola	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Gaddy	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 9.--Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AdC--------------- Aledo	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
AdE*:						
Aledo------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Brackett---------	Moderate: too clayey, slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: small stones, droughty, slope.
AsB--------------- Austin	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Severe: too clayey.
AuC*:						
Austin-----------	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Severe: too clayey.
Urban land-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable.
AxB--------------- Axtell	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
BaA--------------- Bastsil	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
BaB*:						
Bastsil----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
Urban land-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable-------	Variable.
BgB--------------- Bolar	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: small stones, large stones, thin layer.
Bh---------------- Bosque	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
BnA, BnB---------- Branyon	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
BrB--------------- Bremond	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.

See footnote at end of table.

Table 9.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
BuA: Burleson	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
CaB: Chazos	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: droughty.
CfB: Crawford	Severe: depth to rock, cutbanks cave.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
CrB: Crockett	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
DeB: Denton	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Severe: too clayey.
DsC: Desan	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
DuB: Dutek	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
EcB: Eckrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: depth to rock, low strength.
EdD: Eddy	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, large stones.	Severe: small stones, thin layer.
EeD*:						
Eddy	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, large stones.	Severe: small stones, thin layer.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
EsE: Ellis	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Severe: too clayey.
FaB: Fairlie	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
FbB*:						
Fairlie	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
FeE2: Ferris	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Severe: too clayey.

See footnote at end of table.

Table 9.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Fr: Frio	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: too clayey.
Ga: Gaddy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
GhD: Gholson	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.	Slight.
Go: Gowen	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
HeB, HeC, HeD, HgB: Heiden	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
HoB: Houston Black	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
KrC: Krum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
LaD: Lamar	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
LeB: Lewisville	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
LoB, LoD: Lott	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Severe: too clayey.
MaA: Mabank	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
MbA*:						
Mabank	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
Bremond	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
McE: McLennan	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Severe: shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: large stones, slope.
MnB: Minwells	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.

See footnote at end of table.

Table 9.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
MnC2: Minwells	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
OgB: Oglesby	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock, too clayey.
Ov: Ovan	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: flooding, too clayey.
PcB: Payne	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Pg*, Pr*. Pits						
PvB: Purves	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock, too clayey.
QuC: Queeny	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
ReF*: Real	Severe: depth to rock, cemented pan, slope.	Severe: slope.	Severe: depth to rock, cemented pan, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Rock outcrop.						
RgB: Riesel	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: small stones, droughty.
SaB: San Saba	Severe: depth to rock, cutbanks cave.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
SgB: Sanger	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Sh: Ships	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
SsB: Slidell	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
StC*: Stephen	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Severe: thin layer, too clayey.

See footnote at end of table.

Table 9.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
StC*:						
Eddy	Severe: depth to rock.	Moderate: depth to rock, large stones.	Severe: depth to rock.	Moderate: depth to rock, large stones.	Moderate: depth to rock, large stones.	Severe: small stones, thin layer.
SuD*:						
Stephen	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Severe: thin layer, too clayey.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
SyB: Styx	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Moderate: droughty.
SzB: Sunev	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
Tn: Tinn	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
To: Tinn	Severe: cutbanks cave.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: flooding, too clayey.
Ur*: Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Wd, We: Weswood	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
WnA: Wilson	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: droughty.
Ya: Yahola	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Yg*:						
Yahola	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Gaddy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 10.--Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AdC Aledo	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, small stones.
AdE*:					
Aledo	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, small stones.
Brackett	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
AsB Austin	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
AuC*:					
Austin	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Urban land	Variable	Variable	Variable	Variable	Variable.
AxB Axtell	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
BaA Bastsil	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
BaB*:					
Bastsil	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
Urban land	Variable	Variable	Variable	Variable	Variable.
BgB Bolar	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
Bh Bosque	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey, thin layer.
BnA Branyon	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
BnB Branyon	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

See footnote at end of table.

Table 10.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BrB Bremond	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
BuA Burleson	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
CaB Chazos	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Slight	Poor: hard to pack.
CfB Crawford	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
CrB Crockett	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
DeB Denton	Moderate: depth to rock, percs slowly.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: depth to rock.	Poor: hard to pack.
DsC Desan	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
DuB Dutek	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
EcB Eckrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
EdD Eddy	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim.
EeD*:					
Eddy	Severe: depth to rock.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim.
Urban land	Variable	Variable	Variable	Variable	Variable.
EsE Ellis	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
FaB Fairlie	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.

See footnote at end of table.

Table 10.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
FbB*:					
Fairlie	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
Urban land	Variable	Variable	Variable	Variable	Variable.
FeE2 Ferris	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Fr Frio	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Ga Gaddy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
GhD Gholson	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too clayey.
Go Gowen	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
HeB, HeC, HeD, HgB Heiden	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
HoB Houston Black	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
KrC Krum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LaD Lamar	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
LeB Lewisville	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LoB, LoD Lott	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
MaA Mabank	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
MbA*:					
Mabank	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.

See footnote at end of table.

Table 10.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MbA*:					
Bremond	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
McE McLennan	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
MnB, MnC2 Minwells	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Poor: thin layer.
OgB Oglesby	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Ov Ovan	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
PcB Payne	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Pg*, Pr*. Pits					
PvB Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
QuC Queeny	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: cemented pan.
ReF*:					
Real	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock, slope.	Severe: depth to rock, cemented pan, slope.	Poor: depth to rock, small stones, slope.
Rock outcrop.					
RgB Riesel	Severe: percs slowly.	Severe: seepage.	Severe: seepage, too clayey.	Slight	Poor: too clayey, small stones.
SaB San Saba	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
SgB Sanger	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Sh Ships	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.

See footnote at end of table.

Table 10.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
SsB: Slidell	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
StC*:					
Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Eddy	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim.
SuD*:					
Stephen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Urban land	Variable	Variable	Variable	Variable	Variable.
SyB: Styx	Moderate: wetness.	Severe: seepage.	Moderate: wetness, too clayey.	Severe: seepage.	Fair: too clayey.
SzB: Sunev	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
Tn: Tinn	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: flooding.	Poor: too clayey, hard to pack.
To: Tinn	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Ur*: Urban land	Variable	Variable	Variable	Variable	Variable.
Wd, We: Weswood	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
WnA: Wilson	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Ya: Yahola	Moderate: flooding.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Yg*:					
Yahola	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
Gaddy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 11.--Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AdC: Aledo	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
AdE*:				
Aledo	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Brackett	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
AsB: Austin	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
AuC*:				
Austin	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Urban land	Variable	Variable	Variable	Variable.
AxB: Axtell	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BaA: Bastsil	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
BaB*:				
Bastsil	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Urban land	Variable	Variable	Variable	Variable.
BgB: Bolar	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Bh: Bosque	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
BnA, BnB: Branyon	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BrB: Bremond	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BuA: Burleson	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
CaB: Chazos	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
CfB: Crawford	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
CrB: Crockett	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
DeB: Denton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
DsC: Desan	Good	Probable	Improbable: too sandy.	Poor: too sandy.
DuB: Dutek	Good	Probable	Improbable: too sandy.	Poor: too sandy.
EcB: Eckrant	Poor: depth to rock, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, too clayey, large stones.
EdD: Eddy	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
EeD*:				
Eddy	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Urban land	Variable	Variable	Variable	Variable.
EsE: Ellis	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
FaB: Fairlie	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
FbB*:				
Fairlie	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Urban land	Variable	Variable	Variable	Variable.
FeE2: Ferris	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Fr: Frio	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ga-------------------- Gaddy	Good	Probable	Improbable: too sandy.	Poor: too sandy.
GhD------------------- Gholson	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Go-------------------- Gowen	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
HeB, HeC, HeD, HgB---- Heiden	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
HoB------------------- Houston Black	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
KrC------------------- Krum	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LaD------------------- Lamar	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
LeB------------------- Lewisville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LoB, LoD-------------- Lott	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
MaA------------------- Mabank	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
MbA*:				
Mabank---------------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Bremond--------------	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
McE------------------- McLennan	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess lime.
MnB, MnC2------------- Minwells	Good	Probable	Probable	Poor: too clayey.
OgB------------------- Oglesby	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey.
Ov-------------------- Ovan	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
PcB: Payne	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Pg*, Pr*. Pits				
PvB: Purves	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
QuC: Queeny	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones.
ReF*:				
Real	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, small stones.
Rock outcrop.				
RgB: Riesel	Good	Probable	Probable	Poor: too clayey, small stones, area reclaim.
SaB: San Saba	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
SgB: Sanger	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Sh: Ships	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
SsB: Slidell	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
StC*:				
Stephen	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, thin layer.
Eddy	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
SuD*:				
Stephen	Poor: area reclaim, low strength, thin layer.	Improbable: excess fines, thin layer.	Improbable: excess fines, thin layer.	Poor: area reclaim, too clayey, thin layer.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SuD*:				
Urban land	Variable	Variable	Variable	Variable.
SyB Styx	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
SzB Sunev	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, area reclaim.
Tn, To Tinn	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ur* Urban land	Variable	Variable	Variable	Variable.
Wd, We Weswood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
WnA Wilson	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ya Yahola	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Yg*:				
Yahola	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Gaddy	Good	Probable	Improbable: too sandy.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 12.--Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
AdC: Aledo	Severe: depth to rock.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty.
AdE*:						
Aledo	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Brackett	Severe: slope.	Moderate: piping.	Deep to water	Slope, droughty.	Slope	Slope, droughty.
AsB: Austin	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, depth to rock.	Depth to rock	Depth to rock.
AuC*:						
Austin	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, depth to rock.	Depth to rock	Depth to rock.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
AxB: Axtell	Slight	Severe: hard to pack.	Deep to water	Droughty, soil blowing.	Erodes easily, percs slowly.	Erodes easily, droughty.
BaA: Bastsil	Moderate: seepage.	Moderate: piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
BaB*:						
Bastsil	Moderate: seepage.	Moderate: piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
BgB: Bolar	Moderate: seepage, depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Bh: Bosque	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
BnA, BnB: Branyon	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
BrB: Bremond	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
BuA: Burleson	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
CaB: Chazos	Slight	Moderate: hard to pack.	Deep to water	Droughty, fast intake.	Soil blowing, percs slowly.	Droughty, percs slowly.
CfB: Crawford	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Depth to rock, percs slowly.	Depth to rock, percs slowly.

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
CrB Crockett	Slight	Severe: hard to pack.	Deep to water	Slope, droughty, percs slowly.	Erodes easily, percs slowly.	Erodes easily, droughty.
DeB Denton	Moderate: seepage, depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Slow intake, percs slowly.	Erodes easily	Erodes easily, percs slowly.
DsC Desan	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
DuB Dutek	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
EcB Eckrant	Severe: depth to rock.	Severe: hard to pack, large stones.	Deep to water	Large stones, droughty.	Large stones, droughty.	Large stones, droughty, depth to rock.
EdD Eddy	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
EeD*:						
Eddy	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
EsE Ellis	Slight	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
FaB Fairlie	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
FbB*:						
Fairlie	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
FeE2 Ferris	Slight	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Slope, percs slowly.	Slope, percs slowly.
Fr Frio	Slight	Moderate: hard to pack.	Deep to water	Slow intake, flooding.	Favorable	Favorable.
Ga Gaddy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, flooding.	Too sandy, soil blowing.	Droughty.
GhD Gholson	Severe: seepage.	Severe: thin layer.	Deep to water	Slope, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
Go Gowen	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
HeB Heiden	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
HeC, HeD Heiden	Slight	Severe: hard to pack.	Deep to water	Slope, slow intake, percs slowly.	Percs slowly	Percs slowly.
HgB Heiden	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
HoB Houston Black	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
KrC Krum	Slight	Severe: hard to pack.	Deep to water	Slope, slow intake.	Favorable	Favorable.
LaD Lamar	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
LeB Lewisville	Moderate: seepage.	Moderate: piping, hard to pack.	Deep to water	Slow intake	Erodes easily	Erodes easily.
LoB, LoD Lott	Severe: seepage.	Moderate: thin layer, hard to pack.	Deep to water	Slope, slow intake.	Favorable	Favorable.
MaA Mabank	Slight	Severe: hard to pack.	Percs slowly	Percs slowly	Erodes easily, percs slowly.	Erodes easily, percs slowly.
MbA*:						
Mabank	Slight	Severe: hard to pack.	Percs slowly	Percs slowly	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Bremond	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
McE McLennan	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Slope	Slope	Slope.
MnB Minwells	Severe: seepage.	Moderate: thin layer, piping.	Deep to water	Soil blowing, percs slowly.	Soil blowing	Percs slowly.
MnC2 Minwells	Severe: seepage.	Moderate: thin layer, piping.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing	Percs slowly.
OgB Oglesby	Severe: depth to rock.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Ov Ovan	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, flooding.	Percs slowly	Percs slowly.
PcB Payne	Slight	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Pg*, Pr*. Pits						
PvB Purves	Severe: depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock	Depth to rock.
QuC Queeny	Severe: cemented pan.	Severe: thin layer.	Deep to water	Slope, cemented pan.	Cemented pan	Cemented pan.
ReF*:						
Real	Severe: depth to rock, cemented pan, slope.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock, cemented pan.	Slope, droughty, depth to rock.
Rock outcrop.						
RgB Riesel	Severe: seepage.	Moderate: thin layer.	Deep to water	Droughty, percs slowly.	Percs slowly	Droughty, percs slowly.
SaB San Saba	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
SgB Sanger	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
Sh Ships	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
SsB Slidell	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
StC*:						
Stephen	Severe: depth to rock, seepage.	Severe: thin layer.	Deep to water	Slow intake, depth to rock, slope.	Depth to rock	Depth to rock.
Eddy	Severe: depth to rock.	Severe: large stones.	Deep to water	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty.
SuD*:						
Stephen	Severe: depth to rock, seepage.	Severe: thin layer.	Deep to water	Slow intake, depth to rock, slope.	Depth to rock	Depth to rock.
Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
SyB Styx	Severe: seepage.	Moderate: piping.	Deep to water	Droughty, fast intake.	Soil blowing	Droughty.
SzB Sunev	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Tn Tinn	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Percs slowly.
To Tinn	Slight	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, flooding.	Percs slowly	Percs slowly.

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ur*: Urban land	Variable	Variable	Variable	Variable	Variable	Variable.
Wd, We: Weswood	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
WnA: Wilson	Slight	Severe: hard to pack.	Percs slowly	Percs slowly	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Ya: Yahola	Severe: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
Yg*:						
Yahola	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing	Favorable.
Gaddy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, flooding.	Too sandy, soil blowing.	Droughty.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 13.--Engineering Index Properties

(The symbol < means less than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
AdC Aledo	0-4	Gravelly clay loam.	CL, GC, SC	A-4, A-6, A-7	0-20	65-95	60-90	55-90	40-70	27-42	8-22
	4-12	Very gravelly clay loam, very gravelly loam.	GC, SC	A-2-4, A-2-6	0-25	35-65	30-50	25-50	15-35	27-40	8-20
	12-28	Weathered bedrock	---	---	---	---	---	---	---	---	---
AdE*:											
Aledo	0-3	Gravelly clay loam.	CL, GC, SC	A-4, A-6, A-7	0-20	65-95	60-90	55-90	40-70	27-42	8-22
	3-11	Very gravelly clay loam, very gravelly loam.	GC, SC	A-2-4, A-2-6	0-25	35-65	30-50	25-50	15-35	27-40	8-20
	11-20	Weathered bedrock	---	---	---	---	---	---	---	---	---
Brackett	0-10	Gravelly clay loam.	CL, SC, GC	A-6	0-15	70-99	62-88	50-79	43-72	25-40	10-23
	10-16	Loam, clay loam	CL	A-6, A-7-6	0-3	90-100	85-100	65-94	60-87	25-43	10-26
	16-55	Loam, clay loam, silty clay.	CL	A-6, A-7-6	0-3	90-100	85-100	68-98	67-97	25-43	10-26
AsB Austin	0-15	Silty clay	CH, CL	A-7-6	0-5	95-100	90-100	80-100	75-96	45-69	25-44
	15-30	Silty clay, clay, silty clay loam.	CH, CL	A-7-6, A-6	0-5	95-100	90-100	80-100	75-96	35-65	16-40
	30-36	Weathered bedrock	---	---	---	---	---	---	---	---	---
AuC*:											
Austin	0-15	Silty clay	CH, CL	A-7-6	0-5	95-100	90-100	80-100	75-96	45-69	25-44
	15-38	Silty clay, clay, silty clay loam.	CH, CL	A-7-6, A-6	0-5	95-100	90-100	80-100	75-96	35-65	16-40
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Urban land.											
AxB Axtell	0-7	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-2-4, A-4	0	90-100	80-100	75-100	28-75	<31	NP-7
	7-36	Clay loam, clay	CL, CH	A-7-6	0-2	95-100	95-100	85-100	70-98	41-65	25-42
	36-80	Sandy clay loam, clay loam, clay.	CL, CH	A-6, A-7-6	0-2	95-100	95-100	75-100	50-95	35-63	20-45
BaA Bastsil	0-9	Fine sandy loam	ML, SM, CL-ML, SC-SM	A-4	0	95-100	95-100	75-100	36-70	<25	NP-7
	9-80	Loam, clay loam, sandy clay loam.	CL, SC	A-6, A-7-6	0	95-100	90-100	75-100	40-70	26-42	11-26
BaB*:											
Bastsil	0-7	Fine sandy loam	ML, SM, CL-ML, SC-SM	A-4	0	95-100	95-100	75-100	36-70	<25	NP-7
	7-80	Loam, clay loam, sandy clay loam.	CL, SC	A-6, A-7-6	0	95-100	90-100	75-100	40-70	26-42	11-26
Urban land.											

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
BgB-------------- Bolar	0-20	Gravelly clay loam.	CL, SC, CH, GC	A-6, A-7	0-15	60-85	50-78	45-74	36-65	35-57	18-34
	20-28	Loam, clay loam, silty clay loam.	CL, CH	A-6, A-7	0-5	85-100	78-100	70-99	55-93	34-59	16-38
	28-40	Weathered bedrock	---	---	---	---	---	---	---	---	---
Bh--------------- Bosque	0-22	Clay loam--------	CL, CL-ML	A-4, A-6, A-7-6	0	100	96-100	90-100	56-85	23-45	7-25
	22-63	Loam, clay loam, sandy clay loam.	CL, CL-ML	A-6, A-7-6, A-4	0	100	95-100	80-90	50-85	23-45	7-25
	63-80	Loam, clay loam, clay.	CL, CL-ML	A-4, A-6, A-7-6	0	98-100	95-100	85-100	65-94	23-49	7-29
BnA-------------- Branyon	0-4	Clay-------------	CH	A-7-6	0	95-100	85-100	80-100	75-100	54-80	35-55
	4-56	Clay, silty clay	CH	A-7-6	0	95-100	85-100	80-100	75-100	54-80	35-55
	56-80	Clay, silty clay	CH	A-7	0	90-100	85-100	80-100	75-100	54-80	38-60
BnB-------------- Branyon	0-4	Clay-------------	CH	A-7-6	0	95-100	85-100	80-100	75-100	54-80	35-55
	4-68	Clay, silty clay	CH	A-7-6	0	95-100	85-100	80-100	75-100	54-80	35-55
	68-80	Clay, silty clay	CH	A-7	0	90-100	85-100	80-100	75-100	54-80	38-60
BrB-------------- Bremond	0-5	Loam-------------	CL, CL-ML, SC, SM	A-4, A-6	0-2	98-100	95-100	89-100	40-95	16-35	3-15
	5-24	Clay-------------	CH, CL	A-7	0-2	98-100	95-100	85-100	65-98	41-59	23-40
	24-55	Clay loam, clay	CH, CL	A-7	0-2	98-100	95-100	85-100	65-98	41-59	23-40
	55-80	Sandy clay loam, clay loam, clay.	CH, CL	A-7, A-6	0-2	90-100	85-100	75-100	53-98	35-59	20-40
BuA-------------- Burleson	0-24	Clay-------------	CH, CL	A-7-6	0-2	90-100	90-100	90-99	67-97	45-57	28-39
	24-40	Clay, silty clay	CH	A-7-6	0-1	90-100	90-100	90-99	80-99	51-75	34-54
	40-80	Clay, silty clay, clay loam.	CH	A-7-6	0-2	90-100	80-100	75-99	67-98	51-75	34-54
CaB-------------- Chazos	0-15	Loamy fine sand	SM, SC-SM	A-2-4, A-4	0	80-100	75-100	60-98	20-50	<25	NP-4
	15-40	Sandy clay, clay	CL, CH	A-7-6	0	90-100	75-100	75-100	55-85	43-58	21-35
	40-55	Clay loam, sandy clay loam.	CL, CH, SC	A-7-6	0	90-100	75-100	65-95	35-75	43-58	21-35
	55-80	Clay loam, silty clay loam, clay.	CL, CH	A-7-6, A-6	0	90-100	75-100	70-95	50-85	35-55	15-35
CfB-------------- Crawford	0-5	Clay-------------	CH, CL	A-7-6	0-5	85-100	85-100	75-100	70-100	45-75	25-50
	5-38	Clay, silty clay	CH, CL	A-7-6	0-5	85-100	85-100	75-100	70-100	45-75	25-50
	38-48	Weathered bedrock	---	---	---	---	---	---	---	---	---
CrB-------------- Crockett	0-9	Loam-------------	SM, ML, CL, SC	A-4, A-6	0-2	98-100	94-100	89-100	40-96	15-35	3-15
	9-24	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	89-100	75-100	75-100	60-98	35-59	23-42
	24-36	Clay, clay loam, sandy clay.	CH, CL	A-7, A-6	0	89-100	75-100	75-100	65-98	35-59	23-42
	36-55	Clay loam, sandy clay loam, clay.	CL, CH	A-6, A-7	0-5	90-100	85-100	75-100	50-90	30-60	15-40
	55-80	Stratified loam to clay.	CH, CL	A-7	0-5	90-100	90-100	90-100	70-99	45-71	27-52

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
DeB-------------- Denton	0-14	Silty clay-------	CH	A-7	0	97-100	94-100	90-100	85-98	50-70	29-45
	14-22	Silty clay, silty clay loam.	CH, CL	A-7	0	97-100	94-100	90-100	80-98	45-63	25-40
	22-36	Silty clay loam, silt loam, loam.	CH, CL	A-7, A-6	0-15	95-100	91-100	80-100	70-97	36-58	17-36
	36-52	Gravelly silty clay loam, cobbly silt loam, gravelly silt loam.	GC, SC, CL, CH	A-2-6, A-2-7, A-6	1-25	44-73	32-61	26-55	25-54	36-58	17-36
	52-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
DsC-------------- Desan	0-7	Loamy fine sand	SM, SP-SM, SC-SM	A-2-4, A-3	0	98-100	95-100	85-100	8-28	16-25	NP-5
	7-65	Loamy fine sand, fine sand.	SM, SP-SM, SC-SM	A-2-4, A-3	0	98-100	95-100	85-100	8-28	16-25	NP-5
	65-80	Sandy clay loam, fine sandy loam.	SC	A-2, A-4, A-6	0	98-100	95-100	90-100	25-50	20-36	8-20
DuB-------------- Dutek	0-8	Loamy fine sand	SM, SP-SM	A-2, A-3	0	95-100	95-100	85-100	9-25	<22	NP-3
	8-30	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	85-100	9-25	<22	NP-3
	30-58	Sandy clay loam, clay loam, sandy clay.	CL, SC, SC-SM, CL-ML	A-2, A-4, A-6	0	98-100	95-100	90-100	30-55	24-40	6-20
	58-80	Loamy fine sand, fine sandy loam.	SM, SC-SM, SP-SM	A-2	0	95-100	95-100	85-100	10-35	<25	NP-7
EcB-------------- Eckrant	0-4	Cobbly silty clay	CL, CH	A-7-6	10-50	75-100	71-100	70-98	65-94	47-73	25-45
	4-15	Very cobbly clay, very stony clay, extremely stony clay.	CL, GC, CH, SC	A-7-6	15-75	56-85	50-79	45-75	44-74	47-73	25-45
	15-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
EdD-------------- Eddy	0-4	Gravelly clay loam.	GC	A-2, A-6	0-20	40-50	35-50	30-45	20-40	30-40	11-20
	4-8	Gravelly clay loam, very gravelly loam, very gravelly clay loam.	GC, GP-GC	A-2	0-60	20-50	15-45	10-38	8-35	30-40	11-20
	8-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
EeD*:											
Eddy------------	0-4	Gravelly clay loam.	GC	A-2, A-6	0-20	40-50	35-50	30-45	20-40	30-40	11-20
	4-10	Gravelly clay loam, very gravelly loam, very gravelly clay loam.	GC, GP-GC	A-2	0-60	20-50	15-45	10-38	8-35	30-40	11-20
	10-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
EsE-------------- Ellis	0-4	Clay-------------	CH	A-7-6	0-5	95-100	95-100	95-100	75-95	51-75	30-50
	4-28	Clay-------------	CH	A-7-6	0-5	95-100	95-100	95-100	75-95	51-75	30-50
	28-60	Clay-------------	CH	A-7-6	0-5	95-100	95-100	90-100	75-95	51-75	30-50
FaB-------------- Fairlie	0-5	Clay-------------	CH, CL	A-7	0	95-100	90-100	90-100	85-100	41-70	25-45
	5-32	Silty clay, clay	CH	A-7	0	95-100	95-100	90-100	85-100	51-80	28-53
	32-42	Silty clay, clay	CH	A-7	0	95-100	90-100	90-100	80-98	51-80	28-53
	42-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
FbB*:											
Fairlie---------	0-14	Clay-------------	CH, CL	A-7	0	95-100	90-100	90-100	85-100	41-70	25-45
	14-32	Silty clay, clay	CH	A-7	0	95-100	95-100	90-100	85-100	51-80	28-53
	32-45	Silty clay, clay	CH	A-7	0	95-100	90-100	90-100	80-98	51-80	28-53
	45-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Urban land.											
FeE2------------- Ferris	0-6	Clay-------------	CH	A-7-6	0	92-100	92-100	75-100	75-100	51-76	35-55
	6-38	Clay, silty clay	CH	A-7-6	0	92-100	92-100	75-100	72-100	51-78	35-56
	38-60	Clay-------------	CH	A-7-6	0	92-100	92-100	85-100	75-100	61-100	42-75
Fr--------------- Frio	0-4	Silty clay-------	CL, CH	A-6, A-7	0-2	90-100	85-100	85-100	69-100	36-59	17-34
	4-42	Silty clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-2	90-100	85-100	85-100	69-100	36-59	17-34
	42-80	Silty clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-5	90-100	90-100	85-100	68-100	36-59	17-34
Ga--------------- Gaddy	0-8	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	0-14	NP-4
	8-80	Stratified fine sand to clay loam.	SM, ML, SP-SM, CL	A-2, A-3, A-4, A-6	0	100	98-100	80-100	5-90	0-40	NP-18
GhD-------------- Gholson	0-8	Fine sandy loam	ML, CL-ML, SC-SM, SM	A-4	0	95-100	90-100	70-90	36-65	<28	NP-7
	8-48	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	95-100	90-100	80-100	40-75	26-40	11-22
	48-72	Fine sandy loam, loam.	ML, CL-ML, SC-SM, SM	A-4	0	95-100	90-100	90-100	36-70	20-30	2-7
	72-80	Fine sandy loam, loamy fine sand, loamy very fine sand.	SM, SC-SM	A-2, A-4	0	85-100	85-100	80-95	20-50	<26	NP-5
Go--------------- Gowen	0-12	Clay loam--------	CL	A-6, A-7-6	0	100	96-100	85-100	60-85	30-49	15-30
	12-80	Clay loam, loam, sandy clay loam.	CL	A-6, A-7-6	0	100	96-100	80-100	55-85	25-45	11-28
HeB-------------- Heiden	0-6	Clay-------------	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	6-35	Clay, silty clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	35-55	Clay, silty clay	CH, CL	A-7-6	0	95-100	90-100	75-100	70-90	49-80	32-55
	55-80	Clay-------------	CH, CL	A-7-6	0	92-100	92-100	85-100	70-90	49-80	32-55
HeC-------------- Heiden	0-6	Clay-------------	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	6-22	Clay, silty clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	22-52	Clay, silty clay	CH, CL	A-7-6	0	95-100	90-100	75-100	70-90	49-80	32-55
	52-80	Clay-------------	CH, CL	A-7-6	0	92-100	92-100	85-100	70-90	49-80	32-55

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
HeD--------------	0-6	Clay-------------	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
Heiden	6-14	Clay, silty clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	14-50	Clay, silty clay	CH, CL	A-7-6	0	95-100	90-100	75-100	70-90	49-80	32-55
	50-80	Clay-------------	CH, CL	A-7-6	0	92-100	92-100	85-100	70-90	49-80	32-55
HgB--------------	0-6	Gravelly clay----	CH	A-7-6	0-10	55-80	55-80	55-80	50-75	58-90	34-60
Heiden	6-38	Clay, silty clay	CH	A-7-6	0	95-100	90-100	80-100	75-99	51-80	32-55
	38-55	Clay, silty clay	CH, CL	A-7-6	0	95-100	90-100	75-100	70-90	49-80	32-55
	55-80	Clay-------------	CH, CL	A-7-6	0	92-100	92-100	85-100	70-90	49-80	32-55
HoB--------------	0-6	Clay-------------	CH	A-7-6	0	97-100	96-100	94-100	88-98	58-90	34-60
Houston Black	6-35	Clay, silty clay	CH	A-7-6	0	98-100	98-100	92-100	88-97	58-98	37-72
	35-80	Clay, silty clay	CH	A-7-6	0	94-100	93-100	87-100	84-99	51-99	32-78
KrC--------------	0-6	Silty clay-------	CH, CL	A-7-6	0	95-100	85-100	85-100	85-95	47-65	25-42
Krum	6-42	Silty clay, clay	CH	A-7-6	0	95-100	85-100	80-100	65-95	51-74	28-50
	42-80	Silty clay loam, silty clay, clay.	CH, CL	A-7-6, A-6	0	85-100	75-100	70-99	65-95	36-60	20-39
LaD--------------	0-6	Clay loam--------	CL, CL-ML	A-6, A-4, A-7-6	0	95-100	95-100	85-100	70-100	20-49	5-31
Lamar											
	6-44	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4, A-7-6	0	95-100	95-100	85-100	70-100	20-49	5-31
	44-80	Clay loam, loam, silty clay loam.	CL, CL-ML	A-6, A-4, A-7-6	0	95-100	95-100	85-100	70-100	20-49	5-31
LeB--------------	0-20	Silty clay-------	CL, CH	A-7	0	95-100	95-100	82-99	77-95	41-61	20-37
Lewisville	20-52	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	95-100	95-100	73-99	72-95	40-60	24-36
	52-80	Silty clay, clay loam, silty clay loam.	CL, CH	A-6, A-7	0	75-100	72-99	69-98	62-95	30-55	12-34
LoB--------------	0-12	Silty clay-------	CL, CH	A-7-6	0	95-100	95-100	85-100	75-95	41-55	22-35
Lott	12-52	Silty clay, silty clay loam, clay.	CL, CH	A-7-6, A-6	0	95-100	95-100	85-100	75-95	33-52	18-35
	52-80	Marl, silty clay loam, silt loam.	CL, CL-ML	A-4, A-6	0-5	90-100	90-100	85-100	75-95	21-39	6-21
LoD--------------	0-16	Silty clay-------	CL, CH	A-7-6	0	95-100	95-100	85-100	75-95	41-55	22-35
Lott	16-44	Silty clay, silty clay loam, clay.	CL, CH	A-7-6, A-6	0	95-100	95-100	85-100	75-95	33-52	18-35
	44-60	Marl, silty clay loam, silt loam.	CL, CL-ML	A-4, A-6	0-5	90-100	90-100	85-100	75-95	21-39	6-21
MaA--------------	0-10	Fine sandy loam	CL, CL-ML, SC-SM, SC	A-4, A-6	0	95-100	95-100	80-98	40-70	19-32	4-15
Mabank											
	10-65	Clay, clay loam	CH, CL	A-7, A-6	0	95-100	95-100	95-100	60-85	38-55	22-37
	65-80	Clay, clay loam	CH, CL	A-7, A-6	0	95-100	95-100	95-100	60-85	38-55	22-37
MbA*:											
Mabank----------	0-7	Fine sandy loam	CL, CL-ML, SC-SM, SC	A-4, A-6	0	95-100	95-100	80-98	40-70	19-32	4-15
	7-60	Clay, clay loam	CH, CL	A-7, A-6	0	95-100	95-100	95-100	60-85	38-55	22-37
	60-80	Clay, clay loam	CH, CL	A-7, A-6	0	95-100	95-100	95-100	60-85	38-55	22-37

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
Bremond---------	0-8	Fine sandy loam	CL, CL-ML, SC, SM	A-4, A-6	0-2	98-100	95-100	89-100	40-95	16-35	3-15
	8-60	Clay-------------	CH, CL	A-7	0-2	98-100	95-100	85-100	65-98	41-59	23-40
	60-80	Sandy clay loam, clay loam, clay.	CH, CL	A-7, A-6	0-2	90-100	85-100	75-100	53-98	35-59	20-40
McE------------- McLennan	0-7	Clay loam--------	CL, CH	A-6, A-7-6	0-15	90-100	90-100	85-100	70-95	33-52	18-33
	7-32	Clay loam, silty clay loam.	CL, CH	A-6, A-7-6	0-15	90-100	90-100	90-100	70-95	34-52	18-33
	32-80	Clay, silty clay loam, loam.	CL, CH	A-6, A-7-6	0-15	90-100	90-100	90-100	70-95	33-65	15-40
MnB------------- Minwells	0-8	Fine sandy loam	CL, CL-ML, SC-SM, SC	A-2, A-4, A-6	0	96-100	90-100	80-98	30-60	<30	NP-15
	8-38	Clay, clay loam, sandy clay.	CL	A-7-6, A-6	0	95-100	90-100	85-98	50-80	32-50	15-32
	38-60	Clay loam, sandy clay loam, gravelly sandy clay loam.	CL, SC	A-6, A-7-6, A-4	0	85-100	80-100	65-98	45-80	23-45	8-26
	60-80	Very gravelly sand, very gravelly sandy loam, gravelly sandy clay loam.	SC, GM, SP-SM, GP-GM	A-1, A-2	0-5	15-75	10-60	5-50	5-30	<44	NP-28
MnC2------------ Minwells	0-4	Fine sandy loam	CL, CL-ML, SC-SM, SC	A-2, A-4, A-6	0	96-100	90-100	80-98	30-60	<30	NP-15
	4-28	Clay, clay loam, sandy clay.	CL	A-7-6, A-6	0	95-100	90-100	85-98	50-80	32-50	15-32
	28-60	Clay loam, sandy clay loam, gravelly sandy clay loam.	CL, SC	A-6, A-7-6, A-4	0	85-100	80-100	65-98	45-80	23-45	8-26
	60-80	Very gravelly sand, very gravelly sandy loam, gravelly sandy clay loam.	SC, GM, SP-SM, GP-GM	A-1, A-2	0-5	15-75	10-60	5-50	5-30	<44	NP-28
OgB------------- Oglesby	0-18	Silty clay-------	CH	A-7-6	0-5	90-100	90-100	85-100	75-100	55-75	30-45
	18-35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Ov-------------- Ovan	0-20	Silty clay-------	CL, CH	A-7-6	0	100	100	90-100	85-100	48-70	25-45
	20-80	Clay, silty clay	CH	A-7	0	100	100	90-100	85-100	55-75	35-54
PcB------------- Payne	0-8	Clay loam--------	CL	A-6, A-4	0	95-100	95-100	90-100	60-80	25-36	8-16
	8-30	Clay, clay loam	CL, CH	A-7-6	0	95-100	95-100	85-100	70-90	45-60	25-36
	30-72	Clay, clay loam	CL, CH	A-7-6, A-6	0-5	85-100	80-100	70-90	55-90	35-55	20-36
Pg*, Pr*. Pits											

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
PvB-------------- Purves	0-9	Clay-------------	CH	A-7-6, A-7-5	0-5	90-100	80-100	80-98	70-95	51-71	25-40
	9-15	Gravelly clay, very gravelly clay, gravelly clay loam.	CH, GC	A-7-6	0-35	50-65	50-60	50-60	45-55	51-65	30-40
	15-35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
QuC-------------- Queeny	0-12	Clay loam--------	CL, SC, CH	A-6, A-7-6	0-5	75-95	75-95	50-95	40-75	30-52	12-31
	12-20	Cemented---------	---	---	---	---	---	---	---	---	---
	20-60	Variable---------	---	---	---	---	---	---	---	---	---
ReF*:											
Real------------	0-6	Gravelly clay loam.	SM, GM, ML, CL	A-4, A-6, A-7	1-5	65-90	50-77	45-65	36-60	30-55	8-25
	6-14	Extremely gravelly loam, extremely gravelly clay loam, very gravelly clay loam.	GM, GC, SM, SC	A-2, A-4, A-6, A-7	0-15	25-75	20-50	20-45	20-40	30-55	8-25
	14-40	Weathered bedrock, variable.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
RgB-------------- Riesel	0-16	Gravelly fine sandy loam.	GP-GM, SM, GM, SC	A-1, A-2-4, A-2-6	0-5	25-88	15-85	12-70	5-30	16-33	3-17
	16-48	Very gravelly clay, very gravelly clay loam.	GC, SC	A-2-7, A-7	0-5	25-70	25-50	18-50	15-45	41-60	23-40
	48-55	Clay, gravelly clay, very gravelly clay.	GC, SC, CL, CH	A-2-7, A-7	0-5	25-92	20-85	14-80	8-75	41-81	20-54
	55-80	Gravelly fine sand, very gravelly loamy sand.	GP-GM	A-1	5-10	10-40	10-30	10-15	6-10	---	NP-4
SaB-------------- San Saba	0-18	Clay-------------	CH	A-7-6	0	90-100	85-100	80-100	75-100	55-70	30-45
	18-38	Clay-------------	CH	A-7-6	0	95-100	90-100	80-100	75-100	55-70	30-45
	38-48	Weathered bedrock	---	---	---	---	---	---	---	---	---
SgB-------------- Sanger	0-6	Clay-------------	CH, CL	A-7-6	0	95-100	95-100	90-100	80-95	40-60	28-42
	6-34	Clay, silty clay	CH, CL	A-7-6	0	95-100	94-100	90-100	80-100	40-60	28-42
	34-66	Clay, silty clay	CH, CL	A-7-6	0	95-100	94-100	90-100	85-100	40-60	20-36
	66-80	Clay, silty clay, clay loam.	CH, CL	A-7-6, A-6	0	95-100	94-100	85-100	75-100	39-55	20-35
Sh--------------- Ships	0-10	Clay-------------	CH	A-7-6	0	100	100	95-100	95-100	55-75	35-50
	10-74	Clay-------------	CH	A-7-6	0	100	100	95-100	95-100	55-75	35-50
	74-80	Clay, silty clay, silty clay loam.	CH	A-7-6	0	100	100	95-100	85-100	51-70	32-50

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
SsB-------------- Slidell	0-20	Clay-------------	CH	A-7-6	0	95-100	95-100	95-100	85-100	50-67	31-46
	20-37	Silty clay, clay	CH	A-7-6	0	95-100	95-100	95-100	85-100	50-67	31-46
	37-72	Silty clay, clay	CH, CL	A-7-6, A-6	0	95-100	93-100	85-100	70-98	34-51	18-30
StC*:											
Stephen---------	0-8	Silty clay-------	CL, CH	A-7-6	0-5	85-100	75-100	65-100	51-90	45-70	22-42
	8-12	Variable---------	---	---	---	---	---	---	---	---	---
	12-28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Eddy------------	0-5	Gravelly clay loam.	GC	A-2, A-6	0-20	40-50	35-50	30-45	20-40	30-40	11-20
	5-9	Gravelly clay loam, very gravelly loam, very gravelly clay loam.	GC, GP-GC	A-2	0-60	20-50	15-45	10-38	8-35	30-40	11-20
	9-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
SuD*:											
Stephen---------	0-10	Silty clay-------	CL, CH	A-7-6	0-5	85-100	75-100	65-100	51-90	45-70	22-42
	10-15	Variable---------	---	---	---	---	---	---	---	---	---
	15-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Urban land.											
SyB-------------- Styx	0-8	Loamy fine sand	SM, SC-SM	A-2-4, A-4	0	100	100	70-100	15-40	<25	NP-4
	8-27	Fine sand, loamy fine sand.	SM, SC-SM	A-2-4, A-4	0	100	100	70-100	15-40	<25	NP-4
	27-80	Sandy clay loam, clay loam.	SC, CL	A-6, A-4	0	100	100	80-100	36-70	20-40	8-20
SzB-------------- Sunev	0-19	Clay loam--------	CL, CH	A-6, A-7-6	0	90-100	80-100	80-100	55-80	30-51	12-32
	19-80	Loam, clay loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	80-100	70-100	65-100	51-70	25-42	8-22
Tn--------------- Tinn	0-5	Clay-------------	CH, CL	A-7	0	95-100	95-100	85-100	80-100	45-75	25-54
	5-80	Clay, silty clay	CH	A-7	0	95-100	90-100	80-100	80-100	55-75	35-54
To--------------- Tinn	0-8	Clay-------------	CH, CL	A-7	0	95-100	95-100	85-100	80-100	45-75	25-54
	8-80	Clay, silty clay	CH	A-7	0	95-100	90-100	80-100	80-100	55-75	35-54
Ur*. Urban land											
Wd--------------- Weswood	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	98-100	90-100	65-95	20-35	5-18
	6-60	Very fine sandy loam, loam, silt loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	70-98	20-40	5-22
	60-80	Silty clay loam, silty clay.	CL, CH	A-7-6	0	100	98-100	95-100	75-100	40-60	22-40

See footnote at end of table.

Table 13.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
We--------------- Weswood	0-8	Silty clay loam	CL	A-4, A-6	0	100	98-100	95-100	75-98	20-40	9-22
	8-60	Very fine sandy loam, loam, silt loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	70-98	20-40	5-22
	60-80	Silty clay loam, silty clay.	CL, CH	A-7-6	0	100	98-100	95-100	75-100	40-60	22-40
WnA-------------- Wilson	0-8	Clay loam--------	CL	A-6, A-7-6	0	95-100	85-100	80-100	60-96	38-49	20-30
	8-47	Silty clay, clay, clay loam.	CL, CH	A-7-6	0	90-100	80-100	80-100	65-96	43-56	26-37
	47-80	Silty clay, clay, silty clay loam.	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	70-96	38-65	24-48
Ya--------------- Yahola	0-12	Loam-------------	ML, CL-ML, CL	A-4	0	100	100	95-100	65-85	<31	NP-10
	12-28	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL, SC	A-4	0	100	95-100	90-100	36-85	<30	NP-10
	28-80	Stratified loam to loamy fine sand.	SM, ML, CL, SC	A-2, A-4	0	100	95-100	90-100	15-85	<30	NP-10
Yg*: Yahola-----------	0-10	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	10-42	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL, SC	A-4	0	100	95-100	90-100	36-85	<30	NP-10
	42-80	Stratified loam to loamy fine sand.	SM, ML, CL, SC	A-2, A-4	0	100	95-100	90-100	15-85	<30	NP-10
Gaddy-----------	0-8	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	0-14	NP-4
	8-80	Stratified fine sand to clay loam.	SM, ML, SP-SM, CL	A-2, A-3, A-4, A-6	0	100	98-100	80-100	5-90	0-40	NP-18

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 14.--Physical and Chemical Properties of the Soils

(The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
AdC--------------	0-4	20-35	1.20-1.50	0.6-2.0	0.07-0.18	7.9-8.4	0-2	Moderate	0.10	1	8	1-3
Aledo	4-12	20-35	1.20-1.50	0.6-2.0	0.05-0.12	7.9-8.4	0-2	Low-------	0.10			
	12-28	---	---	0.6-2.0	---	---	---	----------	----			
AdE*:												
Aledo-----------	0-3	20-35	1.20-1.50	0.6-2.0	0.07-0.18	7.9-8.4	0-2	Moderate	0.10	1	8	1-3
	3-11	20-35	1.20-1.50	0.6-2.0	0.05-0.12	7.9-8.4	0-2	Low-------	0.10			
	11-20	---	---	0.6-2.0	---	---	---	----------	----			
Brackett--------	0-10	10-35	1.30-1.50	0.6-2.0	0.08-0.12	7.9-8.4	0-2	Low-------	0.17	2	8	1-3
	10-16	18-35	1.30-1.55	0.6-2.0	0.11-0.16	7.9-8.4	0-2	Low-------	0.32			
	16-55	18-45	1.35-1.65	0.2-0.6	0.10-0.15	7.9-8.4	0-2	Low-------	0.32			
AsB--------------	0-15	35-55	1.30-1.40	0.2-0.6	0.15-0.20	7.9-8.4	<2	High------	0.32	3	4	1-4
Austin	15-30	35-55	1.40-1.50	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
	30-36	---	---	0.06-2.0	---	---	---	----------	----			
AuC*:												
Austin----------	0-15	35-55	1.30-1.40	0.2-0.6	0.15-0.20	7.9-8.4	<2	High------	0.32	3	4	1-4
	15-38	35-55	1.40-1.50	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
	38-60	---	---	0.06-2.0	---	---	---	----------	----			
Urban land.												
AxB--------------	0-7	7-18	1.40-1.60	0.6-2.0	0.11-0.15	5.1-6.5	<2	Low-------	0.43	5	3	.5-1
Axtell	7-36	35-55	1.35-1.60	<0.06	0.07-0.16	4.5-5.5	<2	High------	0.37			
	36-80	25-50	1.50-1.70	0.2-0.6	0.07-0.12	5.6-8.4	<2	High------	0.37			
BaA--------------	0-9	7-20	1.50-1.65	2.0-6.0	0.11-0.15	5.6-7.3	<2	Low-------	0.24	5	3	<2
Bastsil	9-80	18-35	1.50-1.65	0.6-2.0	0.12-0.16	5.6-7.8	<2	Moderate	0.32			
BaB*:												
Bastsil---------	0-7	7-20	1.50-1.65	2.0-6.0	0.11-0.15	5.6-7.3	<2	Low-------	0.24	5	3	<2
	7-80	18-35	1.50-1.65	0.6-2.0	0.12-0.16	5.6-7.8	<2	Moderate	0.32			
Urban land.												
BgB--------------	0-20	20-40	1.20-1.50	0.6-2.0	0.10-0.15	7.9-8.4	<2	Moderate	0.20	3	8	1-3
Bolar	20-28	20-40	1.20-1.50	0.6-2.0	0.11-0.18	7.9-8.4	<2	Moderate	0.32			
	28-40	---	---	0.06-2.0	---	---	---	----------	----			
Bh---------------	0-22	27-35	1.20-1.40	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low-------	0.28	5	4L	1-4
Bosque	22-63	20-35	1.20-1.40	0.6-2.0	0.15-0.20	7.4-8.4	<2	Low-------	0.28			
	63-80	20-45	1.20-1.40	0.6-2.0	0.11-0.18	7.9-8.4	<2	Low-------	0.28			
BnA--------------	0-4	40-60	1.15-1.45	<0.06	0.12-0.18	6.6-8.4	0-2	Very high	0.32	5	4	2-4
Branyon	4-56	40-60	1.20-1.45	<0.06	0.12-0.18	7.4-8.4	0-4	Very high	0.32			
	56-80	40-60	1.20-1.35	<0.06	0.12-0.18	7.9-8.4	0-4	Very high	0.32			
BnB--------------	0-4	40-60	1.15-1.45	<0.06	0.12-0.18	6.6-8.4	0-2	Very high	0.32	5	4	2-4
Branyon	4-68	40-60	1.20-1.45	<0.06	0.12-0.18	7.4-8.4	0-4	Very high	0.32			
	68-80	40-60	1.20-1.35	<0.06	0.12-0.18	7.9-8.4	0-4	Very high	0.32			

See footnote at end of table.

Table 14.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
BrB-------------- Bremond	0-5	10-18	1.45-1.60	0.6-2.0	0.11-0.20	5.6-7.3	<2	Low-------	0.43	5	5	1-2
	5-24	40-50	1.35-1.50	<0.06	0.14-0.18	5.6-7.3	<2	High------	0.32			
	24-55	30-50	1.40-1.65	<0.06	0.15-0.18	6.1-8.4	<2	High------	0.32			
	55-80	27-50	1.40-1.65	<0.06	0.15-0.18	6.6-8.4	2-8	High------	0.32			
BuA-------------- Burleson	0-24	40-60	1.35-1.50	<0.06	0.12-0.18	6.1-8.4	<2	Very high	0.32	5	4	1-3
	24-40	40-60	1.40-1.55	<0.06	0.12-0.18	6.1-8.4	0-4	Very high	0.32			
	40-80	35-60	1.40-1.55	<0.06	0.12-0.18	7.4-8.4	0-4	Very high	0.32			
CaB-------------- Chazos	0-15	2-12	1.40-1.60	2.0-6.0	0.06-0.10	5.6-7.3	<2	Low-------	0.20	5	2	<1
	15-40	35-50	1.35-1.50	0.06-0.2	0.10-0.18	5.6-6.5	<2	Moderate	0.32			
	40-55	20-40	1.35-1.55	0.06-0.2	0.10-0.18	5.6-7.3	<2	Moderate	0.32			
	55-80	27-45	1.40-1.60	0.06-0.2	0.10-0.18	6.1-8.4	<2	Moderate	0.32			
CfB-------------- Crawford	0-5	40-60	1.30-1.55	<0.06	0.12-0.15	6.1-8.4	0	Very high	0.32	2	4	1-3
	5-38	40-60	1.30-1.55	<0.06	0.12-0.15	6.1-8.4	0-2	Very high	0.32			
	38-48	---	---	0.2-2.0	---	---	---	----------	----			
CrB-------------- Crockett	0-9	5-20	1.50-1.60	0.6-2.0	0.11-0.20	5.6-7.3	<2	Low-------	0.43	4	5	.5-2
	9-24	40-55	1.35-1.60	<0.06	0.08-0.14	5.6-7.3	<4	High------	0.32			
	24-36	35-55	1.40-1.65	<0.06	0.08-0.14	6.1-8.4	<4	High------	0.32			
	36-55	20-50	1.50-1.70	<0.06	0.11-0.15	6.1-8.4	<4	Moderate	0.32			
	55-80	30-60	1.50-1.70	<0.06	0.11-0.15	6.1-8.4	<4	High------	0.32			
DeB-------------- Denton	0-14	35-57	1.18-1.32	0.06-0.2	0.12-0.18	7.9-8.4	<2	High------	0.32	3	4	1-4
	14-22	35-55	1.28-1.50	0.06-0.2	0.12-0.18	7.9-8.4	<2	High------	0.32			
	22-36	20-37	1.40-1.65	0.6-2.0	0.11-0.14	7.9-8.4	<2	Moderate	0.43			
	36-52	12-35	1.40-1.65	0.6-2.0	0.08-0.12	7.9-8.4	<2	Moderate	0.43			
	52-60	---	---	0.06-2.0	---	---	---	----------	----			
DsC-------------- Desan	0-7	2-12	1.30-1.60	6.0-20	0.05-0.08	5.1-7.3	0	Low-------	0.20	5	2	.3-1
	7-65	2-12	1.30-1.60	6.0-20	0.05-0.08	5.1-7.3	0	Low-------	0.17			
	65-80	12-25	1.35-1.65	0.6-2.0	0.12-0.16	5.1-6.5	0	Low-------	0.24			
DuB-------------- Dutek	0-8	3-12	1.30-1.60	6.0-20	0.05-0.10	5.6-7.3	<2	Low-------	0.20	5	2	<1
	8-30	3-12	1.30-1.60	6.0-20	0.05-0.10	5.6-7.3	<2	Low-------	0.20			
	30-58	18-35	1.30-1.65	0.6-2.0	0.12-0.17	4.5-6.5	<2	Low-------	0.24			
	58-80	5-20	1.30-1.60	2.0-20	0.05-0.10	4.5-6.5	<2	Low-------	0.20			
EcB-------------- Eckrant	0-4	40-60	1.35-1.55	0.2-0.6	0.05-0.12	7.4-8.4	0-2	Moderate	0.15	1	8	2-11
	4-15	40-60	1.35-1.60	0.2-0.6	0.05-0.12	7.4-8.4	0-2	Moderate	0.10			
	15-40	---	---	0.06-2.0	---	---	---	----------	----			
EdD-------------- Eddy	0-4	20-40	1.30-1.50	0.6-2.0	0.10-0.13	7.9-8.4	<2	Low-------	0.24	1	8	<2
	4-8	20-40	1.30-1.50	0.6-2.0	0.03-0.07	7.9-8.4	<2	Low-------	0.24			
	8-20	---	---	0.06-2.0	---	---	---	----------	----			
EeD*:												
Eddy------------	0-4	20-40	1.30-1.50	0.6-2.0	0.10-0.13	7.9-8.4	<2	Low-------	0.24	1	8	<2
	4-10	20-40	1.30-1.50	0.6-2.0	0.03-0.07	7.9-8.4	<2	Low-------	0.24			
	10-20	---	---	0.06-2.0	---	---	---	----------	----			
Urban land.												
EsE-------------- Ellis	0-4	40-50	1.35-1.55	<0.06	0.12-0.18	6.6-8.4	<2	High------	0.32	3	4	1-3
	4-28	40-60	1.35-1.55	<0.06	0.12-0.18	6.6-8.4	<2	High------	0.32			
	28-60	40-60	1.40-1.65	<0.06	0.10-0.15	6.6-8.4	<2	High------	0.32			

See footnote at end of table.

Table 14.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
FaB-------------	0-5	35-50	1.35-1.50	<0.06	0.14-0.20	7.4-8.4	0-2	High------	0.32	4	4	1-4
Fairlie	5-32	40-60	1.40-1.55	<0.06	0.14-0.20	7.4-8.4	0-2	High------	0.32			
	32-42	40-60	1.40-1.60	<0.06	0.14-0.20	7.4-8.4	0-2	High------	0.32			
	42-60	---	---	0.06-2.0	---	---	---	----------	----			
FbB*:												
Fairlie---------	0-14	35-50	1.35-1.50	<0.06	0.14-0.20	7.4-8.4	0-2	High------	0.32	4	4	1-4
	14-32	40-60	1.40-1.55	<0.06	0.14-0.20	7.4-8.4	0-2	High------	0.32			
	32-45	40-60	1.40-1.60	<0.06	0.14-0.20	7.4-8.4	0-2	High------	0.32			
	45-60	---	---	0.06-2.0	---	---	---	----------	----			
Urban land.												
FeE2------------	0-6	40-65	1.40-1.50	<0.06	0.15-0.18	7.9-8.4	0-2	Very high	0.32	4	4	.5-2
Ferris	6-38	40-65	1.40-1.50	<0.06	0.12-0.18	7.9-8.4	0-2	Very high	0.32			
	38-60	40-75	1.45-1.65	<0.06	0.11-0.15	7.9-8.4	0-2	High------	0.32			
Fr--------------	0-4	30-50	1.25-1.45	0.2-0.6	0.14-0.20	7.9-8.4	<2	Moderate	0.32	5	4	1-4
Frio	4-42	30-50	1.25-1.45	0.2-0.6	0.14-0.20	7.9-8.4	<2	Moderate	0.32			
	42-80	35-50	1.30-1.55	0.2-0.6	0.14-0.20	7.9-8.4	<2	Moderate	0.32			
Ga--------------	0-8	5-15	1.35-1.50	6.0-20	0.07-0.11	7.4-8.4	0	Low-------	0.17	5	2	0-.5
Gaddy	8-80	5-35	1.50-1.70	6.0-20	0.06-0.10	7.9-8.4	0	Low-------	0.17			
GhD-------------	0-8	5-20	1.35-1.55	2.0-6.0	0.11-0.17	6.1-7.3	<2	Low-------	0.37	5	3	<2
Gholson	8-48	20-35	1.50-1.65	0.6-2.0	0.15-0.19	6.1-7.8	<2	Low-------	0.37			
	48-72	5-20	1.50-1.65	2.0-6.0	0.12-0.16	6.6-8.4	<2	Low-------	0.37			
	72-80	5-20	1.50-1.65	2.0-6.0	0.07-0.15	6.6-8.4	<2	Low-------	0.32			
Go--------------	0-12	27-30	1.35-1.50	0.6-2.0	0.15-0.20	6.6-8.4	0-2	Moderate	0.28	5	6	1-4
Gowen	12-80	20-35	1.40-1.60	0.6-2.0	0.15-0.20	6.6-8.4	0-2	Moderate	0.28			
HeB-------------	0-6	40-60	1.30-1.50	<0.06	0.15-0.20	7.9-8.4	0-2	Very high	0.32	5	4	1-4
Heiden	6-35	40-60	1.35-1.55	<0.06	0.14-0.18	7.9-8.4	0-2	Very high	0.32			
	35-55	40-60	1.40-1.60	<0.06	0.12-0.18	7.9-8.4	0-2	Very high	0.32			
	55-80	40-60	1.45-1.65	<0.06	0.11-0.15	7.9-8.4	0-2	Very high	0.32			
HeC-------------	0-6	40-60	1.30-1.50	<0.06	0.15-0.20	7.9-8.4	0-2	Very high	0.32	5	4	1-4
Heiden	6-22	40-60	1.35-1.55	<0.06	0.14-0.18	7.9-8.4	0-2	Very high	0.32			
	22-52	40-60	1.40-1.60	<0.06	0.12-0.18	7.9-8.4	0-2	Very high	0.32			
	52-80	40-60	1.45-1.65	<0.06	0.11-0.15	7.9-8.4	0-2	Very high	0.32			
HeD-------------	0-6	40-60	1.30-1.50	<0.06	0.15-0.20	7.9-8.4	0-2	Very high	0.32	5	4	1-4
Heiden	6-14	40-60	1.35-1.55	<0.06	0.14-0.18	7.9-8.4	0-2	Very high	0.32			
	14-50	40-60	1.40-1.60	<0.06	0.12-0.18	7.9-8.4	0-2	Very high	0.32			
	50-80	40-60	1.45-1.65	<0.06	0.11-0.15	7.9-8.4	0-2	Very high	0.32			
HgB-------------	0-6	40-60	1.30-1.50	<0.06	0.11-0.18	7.9-8.4	0-2	High------	0.20	5	4	1-4
Heiden	6-38	40-60	1.35-1.55	<0.06	0.14-0.18	7.9-8.4	0-2	Very high	0.32			
	38-55	40-60	1.40-1.60	<0.06	0.12-0.18	7.9-8.4	0-2	Very high	0.32			
	55-80	40-60	1.45-1.65	<0.06	0.11-0.15	7.9-8.4	0-2	Very high	0.32			
HoB-------------	0-6	50-60	1.20-1.40	<0.06	0.15-0.20	7.4-8.4	0-2	Very high	0.32	5	4	1-5
Houston Black	6-35	50-60	1.25-1.50	<0.06	0.12-0.18	7.4-8.4	0-2	Very high	0.32			
	35-80	45-65	1.30-1.55	<0.06	0.10-0.16	7.4-8.4	0-4	Very high	0.32			
KrC-------------	0-6	35-55	1.35-1.55	0.2-0.6	0.15-0.20	7.4-8.4	0-2	High------	0.32	5	4	1-3
Krum	6-42	40-60	1.25-1.50	0.2-0.6	0.12-0.18	7.9-8.4	0-2	High------	0.32			
	42-80	35-60	1.30-1.55	0.2-0.6	0.07-0.18	7.9-8.4	0-2	High------	0.32			

See footnote at end of table.

Table 14.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
LaD-------------- Lamar	0-6	20-35	1.25-1.40	0.6-2.0	0.12-0.15	7.9-8.4	<2	Moderate	0.32	5	4L	1-3
	6-44	20-35	1.30-1.50	0.6-2.0	0.12-0.15	7.9-8.4	<2	Moderate	0.32			
	44-80	20-35	1.35-1.60	0.6-2.0	0.12-0.15	7.9-8.4	<2	Moderate	0.32			
LeB-------------- Lewisville	0-20	28-45	1.20-1.40	0.6-2.0	0.16-0.20	7.9-8.4	<2	High------	0.32	5	4L	1-3
	20-52	30-45	1.20-1.45	0.6-2.0	0.14-0.18	7.9-8.4	<2	High------	0.37			
	52-80	30-50	1.30-1.50	0.6-2.0	0.14-0.18	7.9-8.4	<2	High------	0.37			
LoB-------------- Lott	0-12	35-50	1.20-1.40	0.2-0.6	0.15-0.20	7.9-8.4	<2	High------	0.32	4	4L	1-3
	12-52	35-50	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
	52-80	16-35	1.30-1.60	0.6-2.0	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
LoD-------------- Lott	0-16	35-50	1.20-1.40	0.2-0.6	0.15-0.20	7.9-8.4	<2	High------	0.32	4	4L	1-3
	16-44	35-50	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
	44-60	16-35	1.30-1.60	0.6-2.0	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
MaA-------------- Mabank	0-10	10-25	1.50-1.65	0.6-2.0	0.11-0.15	5.6-7.3	0-2	Low-------	0.43	5	3	1-2
	10-65	35-50	1.45-1.65	<0.6	0.12-0.18	5.6-8.4	0-2	High------	0.32			
	65-80	35-50	1.45-1.65	<0.6	0.12-0.18	5.6-8.4	2-8	High------	0.32			
MbA*:												
Mabank----------	0-7	10-25	1.50-1.65	0.6-2.0	0.11-0.15	6.1-7.3	0-2	Low-------	0.43	5	3	1-2
	7-60	35-50	1.45-1.65	<0.6	0.12-0.18	5.6-8.4	0-2	High------	0.32			
	60-80	35-50	1.45-1.65	<0.6	0.12-0.18	5.6-8.4	2-8	High------	0.32			
Bremond---------	0-8	10-18	1.45-1.60	0.6-2.0	0.11-0.20	5.6-7.3	<2	Low-------	0.43	5	5	1-2
	8-60	40-50	1.35-1.50	<0.06	0.14-0.18	5.6-7.3	<2	High------	0.32			
	60-80	27-50	1.40-1.65	<0.06	0.15-0.18	6.6-8.4	2-8	High------	0.32			
McE-------------- McLennan	0-7	35-40	1.20-1.40	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32	4	4L	<2
	7-32	35-50	1.20-1.50	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
	32-80	35-65	1.30-1.60	0.2-0.6	0.08-0.15	7.9-8.4	<2	High------	0.32			
MnB-------------- Minwells	0-8	10-20	1.40-1.55	2.0-6.0	0.10-0.15	6.1-7.8	<2	Low-------	0.24	5	3	.1-1
	8-38	35-45	1.35-1.60	0.06-0.2	0.11-0.16	6.1-7.8	<2	Moderate	0.32			
	38-60	20-35	1.35-1.60	0.2-0.6	0.10-0.16	6.6-8.4	<2	Moderate	0.32			
	60-80	3-25	1.35-1.60	2.0-6.0	0.01-0.09	6.6-8.4	<2	Low-------	0.15			
MnC2------------- Minwells	0-4	10-20	1.40-1.55	2.0-6.0	0.10-0.15	6.1-7.8	<2	Low-------	0.24	5	3	.1-1
	4-28	35-45	1.35-1.60	0.06-0.2	0.11-0.16	6.1-7.8	<2	Moderate	0.32			
	28-60	20-35	1.35-1.60	0.2-0.6	0.10-0.16	6.6-8.4	<2	Moderate	0.32			
	60-80	3-25	1.35-1.60	2.0-6.0	0.01-0.09	6.6-8.4	<2	Low-------	0.15			
OgB-------------- Oglesby	0-18	40-50	1.25-1.45	0.06-0.2	0.13-0.18	6.6-7.8	<2	High------	0.32	1	4	1-3
	18-35	---	---	0.06-2.0	---	---	---	----------	----			
Ov--------------- Ovan	0-20	40-55	1.40-1.50	0.06-0.2	0.15-0.20	7.9-8.4	0-2	High------	0.32	5	4	1-3
	20-80	40-55	1.40-1.50	<0.06	0.15-0.20	7.9-8.4	0-2	High------	0.32			
PcB-------------- Payne	0-8	20-30	1.40-1.60	0.2-0.6	0.15-0.20	6.1-7.3	<2	Moderate	0.37	5	6	1-3
	8-30	35-55	1.40-1.55	<0.06	0.12-0.18	6.1-7.8	<2	Moderate	0.32			
	30-72	35-55	1.45-1.60	<0.06	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
Pg*, Pr*. Pits												
PvB-------------- Purves	0-9	40-55	1.25-1.45	0.2-0.6	0.12-0.18	7.9-8.4	0-2	High------	0.32	1	4	1-4
	9-15	35-55	1.25-1.45	0.2-0.6	0.08-0.18	7.9-8.4	0-2	High------	0.15			
	15-35	---	---	0.06-2.0	---	---	---	----------	----			

See footnote at end of table.

Table 14.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
QuC--------------	0-12	22-35	1.25-1.42	0.6-2.0	0.14-0.19	7.9-8.4	0-2	Moderate	0.32	2	4L	1-3
Queeny	12-20	---	---	0.01-0.6	---	---	---	----------	----			
	20-60	---	---	0.2-2.0	---	---	---	----------	----			
ReF*:												
Real------------	0-6	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	0	Low-------	0.15	2	8	1-4
	6-14	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	0	Low-------	0.10			
	14-40	---	---	0.2-2.0	---	---	---	----------	----			
Rock outcrop.												
RgB--------------	0-16	5-15	1.40-1.60	2.0-6.0	0.04-0.10	6.1-7.3	<2	Low-------	0.10	4	8	.5-2
Riesel	16-48	35-55	1.35-1.50	0.06-0.2	0.05-0.12	5.6-7.3	<2	Moderate	0.17			
	48-55	35-55	1.40-1.55	0.06-0.2	0.05-0.16	5.6-7.3	<2	Moderate	0.17			
	55-80	3-12	1.45-1.65	6.0-20	0.03-0.05	6.6-8.4	<2	Low-------	0.10			
SaB--------------	0-18	45-60	1.30-1.45	<0.06	0.12-0.16	7.4-8.4	0-2	High------	0.32	2	4	1-4
San Saba	18-38	45-60	1.30-1.50	<0.06	0.12-0.16	7.4-8.4	0-2	High------	0.32			
	38-48	---	---	0.06-2.0	---	---	---	----------	----			
SgB--------------	0-6	40-60	1.40-1.55	<0.06	0.12-0.18	7.9-8.4	0-2	High------	0.32	4	4	1-3
Sanger	6-34	40-60	1.40-1.55	<0.06	0.12-0.18	7.9-8.4	0-2	High------	0.32			
	34-66	40-60	1.40-1.55	<0.06	0.12-0.18	7.9-8.4	0-2	High------	0.32			
	66-80	40-60	1.40-1.60	<0.06	0.12-0.18	7.9-8.4	0-2	High------	0.32			
Sh---------------	0-10	60-80	1.20-1.40	<0.06	0.12-0.18	7.9-8.4	<2	Very high	0.32	5	4	.5-3
Ships	10-74	60-80	1.20-1.40	<0.06	0.12-0.18	7.9-8.4	<2	Very high	0.32			
	74-80	35-80	1.25-1.50	<0.06	0.12-0.18	7.9-8.4	<2	Very high	0.32			
SsB--------------	0-20	40-60	1.25-1.55	<0.06	0.15-0.18	7.4-8.4	0-2	High------	0.32	5	4	1-4
Slidell	20-37	40-60	1.25-1.55	<0.06	0.15-0.18	7.4-8.4	0-2	High------	0.32			
	37-72	40-60	1.35-1.55	<0.06	0.13-0.18	7.4-8.4	0-2	High------	0.32			
StC*:												
Stephen---------	0-8	40-55	1.35-1.55	0.2-0.6	0.10-0.15	7.9-8.4	<2	Moderate	0.32	2	4	1-4
	8-12	---	---	0.06-2.0	---	---	---	----------	----			
	12-28	---	---	0.06-2.0	---	---	---	----------	----			
Eddy------------	0-5	20-40	1.30-1.50	0.6-2.0	0.10-0.13	7.9-8.4	<2	Low-------	0.24	1	8	.5-2
	5-9	20-40	1.30-1.50	0.6-2.0	0.03-0.07	7.9-8.4	<2	Low-------	0.24			
	9-20	---	---	0.06-2.0	---	---	---	----------	----			
SuD*:												
Stephen---------	0-10	40-55	1.35-1.55	0.2-0.6	0.10-0.15	7.9-8.4	<2	Moderate	0.32	2	4	1-4
	10-15	---	---	0.06-2.0	---	---	---	----------	----			
	15-30	---	---	0.06-2.0	---	---	---	----------	----			
Urban land.												
SyB--------------	0-8	3-15	1.40-1.60	2.0-6.0	0.05-0.10	5.1-7.3	<2	Low-------	0.17	5	2	.5-2
Styx	8-27	3-15	1.40-1.60	2.0-6.0	0.05-0.10	5.1-7.3	<2	Low-------	0.17			
	27-80	25-35	1.30-1.65	0.6-2.0	0.12-0.16	5.1-6.5	<2	Low-------	0.24			
SzB--------------	0-19	20-40	1.30-1.50	0.6-2.0	0.11-0.16	7.9-8.4	<2	Moderate	0.28	5	4L	1-3
Sunev	19-80	20-40	1.40-1.60	0.6-2.0	0.11-0.16	7.9-8.4	<2	Low-------	0.28			
Tn---------------	0-5	40-60	1.40-1.50	0.06-0.2	0.15-0.20	7.4-8.4	0-2	Very high	0.32	5	4	1-4
Tinn	5-80	40-60	1.40-1.50	<0.06	0.13-0.18	7.4-8.4	0-2	Very high	0.32			

See footnote at end of table.

Table 14.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
To--------------- Tinn	0-8	40-60	1.40-1.50	0.06-0.2	0.15-0.20	7.4-8.4	0-2	Very high	0.32	5	4	1-4
	8-80	40-60	1.40-1.50	<0.06	0.13-0.18	7.4-8.4	0-2	Very high	0.32			
Ur*. Urban land												
Wd--------------- Weswood	0-6	8-26	1.20-1.35	0.6-2.0	0.12-0.20	7.9-8.4	0-2	Low-------	0.43	5	6	1-4
	6-60	10-20	1.30-1.55	0.6-2.0	0.12-0.20	7.9-8.4	0-2	Low-------	0.43			
	60-80	27-45	1.30-1.55	0.2-0.6	0.13-0.18	7.9-8.4	0-2	Moderate	0.32			
We--------------- Weswood	0-8	27-35	1.20-1.35	0.6-2.0	0.12-0.20	7.9-8.4	0-2	Low-------	0.43	5	6	1-4
	8-60	10-20	1.30-1.55	0.6-2.0	0.12-0.20	7.9-8.4	0-2	Low-------	0.43			
	60-80	27-45	1.30-1.55	0.2-0.6	0.13-0.18	7.9-8.4	0-2	Moderate	0.32			
WnA-------------- Wilson	0-8	27-35	1.35-1.50	0.2-0.6	0.10-0.17	5.6-7.3	0	Moderate	0.43	5	6	.5-2
	8-47	35-50	1.50-1.60	<0.06	0.12-0.15	5.6-7.8	0-4	High------	0.37			
	47-80	35-60	1.50-1.60	<0.06	0.12-0.15	6.6-8.4	2-8	High------	0.37			
Ya--------------- Yahola	0-12	10-18	1.30-1.55	2.0-6.0	0.15-0.20	7.4-8.4	<2	Low-------	0.32	5	4L	.5-1
	12-28	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	<2	Low-------	0.32			
	28-80	5-18	1.50-1.70	2.0-6.0	0.07-0.20	7.9-8.4	<2	Low-------	0.32			
Yg*:												
Yahola----------	0-10	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low-------	0.20	5	3	.5-1
	10-42	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	<2	Low-------	0.32			
	42-80	5-18	1.50-1.70	2.0-6.0	0.07-0.20	7.9-8.4	<2	Low-------	0.32			
Gaddy-----------	0-8	5-15	1.35-1.50	6.0-20	0.07-0.11	7.4-8.4	0	Low-------	0.17	5	2	0-.5
	8-80	5-35	1.50-1.70	6.0-20	0.06-0.10	7.9-8.4	0	Low-------	0.17			

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 15.--Soil and Water Features

("Flooding," "water table," and terms such as "rare," "brief," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
AdC Aledo	C	None	---	---	>6.0	---	---	8-20	Hard	---	---	Moderate	Low.
AdE*:													
Aledo	C	None	---	---	>6.0	---	---	8-20	Hard	---	---	Moderate	Low.
Brackett	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
AsB Austin	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	High	Low.
AuC*:													
Austin	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	High	Low.
Urban land.													
AxB Axtell	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Moderate.
BaA Bastsil	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
BaB*:													
Bastsil	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
Urban land.													
BgB Bolar	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	High	Low.
Bh Bosque	B	Occasional	Brief	Oct-May	>6.0	---	---	>60	---	---	---	High	Low.
BnA, BnB Branyon	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
BrB Bremond	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
BuA Burleson	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Moderate.
CaB Chazos	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Moderate.
CfB Crawford	D	None	---	---	>6.0	---	---	20-40	Hard	---	---	High	Low.
CrB Crockett	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
DeB Denton	D	None	---	---	>6.0	---	---	40-60	Hard	---	---	High	Low.
DsC Desan	A	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Moderate.

See footnote at end of table.

Table 15.--Soil and Water Features--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Cemented pan: Depth	Cemented pan: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
DuB--------------- Dutek	A	None--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Moderate.
EcB--------------- Eckrant	D	None--------	---	---	>6.0	---	---	8-20	Hard	---	---	High-----	Low.
EdD--------------- Eddy	C	None--------	---	---	>6.0	---	---	3-15	Soft	---	---	High-----	Low.
EeD*:													
Eddy-------------	C	None--------	---	---	>6.0	---	---	3-15	Soft	---	---	High-----	Low.
Urban land.													
EsE--------------- Ellis	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
FaB--------------- Fairlie	D	None--------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.
FbB*:													
Fairlie----------	D	None--------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.
Urban land.													
FeE2-------------- Ferris	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
Fr---------------- Frio	B	Occasional	Brief-----	Oct-May	>6.0	---	---	>60	---	---	---	High-----	Low.
Ga---------------- Gaddy	A	Frequent----	Very brief	Mar-Oct	>8.0	---	---	>80	---	---	---	Low------	Low.
GhD--------------- Gholson	B	None--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
Go---------------- Gowen	B	Frequent----	Brief-----	May-Sep	>6.0	---	---	>60	---	---	---	Moderate	Low.
HeB, HeC, HeD, HgB-------------- Heiden	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
HoB--------------- Houston Black	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
KrC--------------- Krum	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
LaD--------------- Lamar	B	None--------	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
LeB--------------- Lewisville	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
LoB, LoD---------- Lott	C	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
MaA--------------- Mabank	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Moderate.

See footnote at end of table.

Table 15.--Soil and Water Features--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Cemented pan: Depth	Cemented pan: Hard-ness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
MbA*:													
Mabank	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Moderate.
Bremond	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
McE McLennan	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
MnB, MnC2 Minwells	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
OgB Oglesby	D	None	---	---	>6.0	---	---	10-20	Hard	---	---	High	Low.
Ov Ovan	D	Frequent	Brief	Mar-Jun	>6.0	---	---	>60	---	---	---	High	Low.
PcB Payne	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
Pg*, Pr*. Pits													
PvB Purves	D	None	---	---	>6.0	---	---	8-20	Hard	---	---	High	Low.
QuC Queeny	D	None	---	---	>6.0	---	---	>60	---	4-20	Thin	Moderate	Low.
ReF*:													
Real	D	None	---	---	>6.0	---	---	9-20	Soft	8-19	Thin	High	Low.
Rock outcrop.													
RgB Riesel	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
SaB San Saba	D	None	---	---	>6.0	---	---	24-40	Hard	---	---	High	Low.
SgB Sanger	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
Sh Ships	D	Rare	---	---	>6.0	---	---	>60	---	---	---	High	Low.
SsB Slidell	D	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
StC*:													
Stephen	C	None	---	---	>6.0	---	---	7-20	Soft	---	---	High	Low.
Eddy	C	None	---	---	>6.0	---	---	3-15	Soft	---	---	High	Low.
SuD*:													
Stephen	C	None	---	---	>6.0	---	---	7-20	Soft	---	---	High	Low.
Urban land.													
SyB Styx	B	None	---	---	4.0-6.0	Perched	Dec-May	>60	---	---	---	Moderate	Moderate.

See footnote at end of table.

Table 15.--Soil and Water Features--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Cemented pan: Depth	Cemented pan: Hard-ness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In		In			
SzB--------------- Sunev	B	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
Tn---------------- Tinn	D	Rare--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
To---------------- Tinn	D	Frequent----	Brief-----	Feb-May	>6.0	---	---	>60	---	---	---	High-----	Low.
Ur*. Urban land													
Wd, We------------ Weswood	B	Rare--------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
WnA--------------- Wilson	D	None--------	---	---	>6.0	---	---	>60	---	---	---	High-----	High.
Ya---------------- Yahola	B	Rare--------	---	---	>6.0	---	---	>60	---	---	---	Low------	Low.
Yg*:													
Yahola-----------	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	---	---	Low------	Low.
Gaddy------------	A	Occasional	Very brief	Mar-Oct	>8.0	---	---	>80	---	---	---	Low------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 16.--Engineering Index Test Data

(Analysis by the Texas Department of Highways and Public Transportation)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution: Percentage passing sieve--						Grain-size distribution: Percentage smaller than--			Liquid limit	Plasticity index	Specific gravity	Shrinkage		
	AASHTO	Unified	3/4 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct			Pct	Pct	
Aledo*																	
THD83TX-309-3-1																	
Ap-------0 to 4	A-7-6(11)	GC	70	63	57	54	51	48	44	23	18	53	32	2.52	11	18.2	1.96
Bastsil**																	
THD85TX-309-1(11-13)																	
A--------0 to 16	A-4(0)	SM	100	100	99	99	92	49	39	11	8	17	2	2.62	11	4.0	1.75
Bt1-----16 to 32	A-7(18)	CL	100	100	100	99	95	72	63	42	38	43	27	2.63	21	10.1	1.92
Bt2-----32 to 46	A-7(20)	CL	100	100	100	99	96	72	64	39	34	46	30	2.65	14	14.8	1.95
Crawford***																	
THD83TX-309-2																	
Ap-------0 to 5	A-7(44)	CH	100	100	100	100	99	96	83	58	50	65	40	2.63	10	22.0	2.03
A--------5 to 11	A-7(50)	CH	100	100	100	99	99	97	80	61	52	70	45	2.68	8	24.0	2.05
Bss1----11 to 27	A-7(47)	CH	100	100	99	99	98	97	85	65	55	68	42	2.67	10	22.5	2.06
Bss2----27 to 34	A-7(1)	GC	52	50	48	46	46	44	39	31	26	63	38	2.69	11	21.2	2.04
Bss3----34 to 38	A-7(8)	CL	82	75	67	62	58	51	49	32	20	43	24	2.70	12	14.8	1.92
Lott****																	
THD84TX-309-1																	
A--------0 to 7	A-7-6(29)	CH	100	99	99	98	95	89	81	48	33	53	30	2.64	12	18.5	2.04
Bk-------7 to 22	A-7-6(25)	CL	95	93	91	88	85	79	74	57	43	48	32	2.71	11	17.4	2.03
BCk-----22 to 36	A-6(19)	CL	100	99	98	95	94	86	79	58	42	38	23	2.69	14	12.0	1.97
Slidell***																	
THD83TX-309-1																	
Ap1------0 to 4	A-7(46)	CH	100	100	100	99	98	94	91	54	41	64	44	2.70	9	22.5	2.08
Ap2------4 to 9	A-7(47)	CH	100	100	100	99	98	95	93	58	45	65	44	2.70	8	23.0	2.07
A--------9 to 20	A-7(50)	CH	100	100	100	100	98	95	93	58	49	67	47	2.70	10	23.0	2.07
Bss-----20 to 37	A-7(47)	CH	100	100	99	95	92	89	82	54	47	69	48	2.70	10	23.0	2.07
Bkss1---37 to 43	A-7(38)	CH	100	100	96	88	84	81	79	54	42	65	45	2.70	8	23.1	2.11
Bkss2---43 to 56	A-7(27)	CL	98	98	95	92	90	83	78	52	34	49	33	2.69	11	16.9	2.05
Wilson*****																	
THD85TX-309-1(6-8)																	
A2-------9 to 18	A-6(20)	CL	100	100	100	100	100	87	76	35	31	40	24	2.58	15	11.9	1.86
Bt1-----18 to 26	A-7-6(44)	CH	100	100	100	100	100	94	83	53	45	61	43	2.65	13	19.8	1.96
Btg1----38 to 58	A-7-6(42)	CH	100	100	100	100	99	95	87	59	50	57	41	2.69	9	20.4	2.07

* Location of pedon sample: from the intersection of U.S. Highway 84 and Farm Road 938, 3.3 miles west of McGregor, 2.5 miles north on Farm Road 938, 1.4 miles west on a gravel road, and 150 north in an area of rangeland.

** Location of pedon sample: from the intersection of Farm Road 1637 and Farm Road 3051, 0.3 mile northwest of Bosqueville, 1.1 miles northwest on Farm Road 1637, 3.0 miles north on Farm Road 3434, and 4,560 feet north and 960 feet northeast of a road in a pasture.

*** Location of pedon sample is the same as that of the typical pedon described in the section "Soil Series and Their Morphology."

**** Location of pedon sample: from the intersection of Farm Road 107 and Farm Road 2113, east of Moody, 1.7 miles north on Farm Road 2113, 0.4 mile west on a gravel road, 0.3 mile north, and 25 feet east of a fence line in a pasture.

***** Location of pedon sample: from the intersection of Farm Road 1637 and Farm Road 3051, about 0.3 mile west of Bosqueville, 1 .1 miles west on Farm Road 1637 and 2,650 feet north and 215 feet northeast along a fence line in a pasture.

Table 17.--Classification of the Soils

Soil name	Family or higher taxonomic class
Aledo	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Austin	Fine-silty, carbonatic, thermic Udorthentic Haplustolls
Axtell	Fine, montmorillonitic, thermic Udertic Paleustalfs
Bastsil	Fine-loamy, siliceous, thermic Udic Paleustalfs
Bolar	Fine-loamy, carbonatic, thermic Udic Calciustolls
Bosque	Fine-loamy, mixed, thermic Cumulic Haplustolls
Brackett	Fine-loamy, carbonatic, thermic Udic Ustochrepts
Branyon	Fine, montmorillonitic, thermic Udic Haplusterts
Bremond	Fine, montmorillonitic, thermic Udertic Paleustalfs
Burleson	Fine, montmorillonitic, thermic Udic Haplusterts
Chazos	Fine, montmorillonitic, thermic Udic Paleustalfs
Crawford	Fine, montmorillonitic, thermic Leptic Udic Haplusterts
Crockett	Fine, montmorillonitic, thermic Udertic Paleustalfs
Denton	Fine-silty, carbonatic, thermic Udic Calciustolls
Desan	Loamy, siliceous, thermic Grossarenic Paleustalfs
Dutek	Loamy, siliceous, thermic Arenic Haplustalfs
Eckrant	Clayey-skeletal, montmorillonitic, thermic Lithic Haplustolls
Eddy	Loamy-skeletal, carbonatic, thermic, shallow Typic Ustorthents
Ellis	Fine, montmorillonitic, thermic Udertic Ustochrepts
Fairlie	Fine, montmorillonitic, thermic Udic Haplusterts
Ferris	Fine, montmorillonitic, thermic Chromic Udic Haplusterts
Frio	Fine, montmorillonitic, thermic Cumulic Haplustolls
Gaddy	Sandy, mixed, thermic Udic Ustifluvents
Gholson	Fine-loamy, siliceous, thermic Udic Haplustalfs
Gowen	Fine-loamy, mixed, thermic Cumulic Haplustolls
Heiden	Fine, montmorillonitic, thermic Udic Haplusterts
Houston Black	Fine, montmorillonitic, thermic Udic Haplusterts
Krum	Fine, montmorillonitic, thermic Udertic Haplustolls
Lamar	Fine-silty, mixed, thermic Udic Ustochrepts
Lewisville	Fine-silty, mixed, thermic Udic Calciustolls
Lott	Fine-silty, carbonatic, thermic Udorthentic Haplustolls
Mabank	Fine, montmorillonitic, thermic Oxyaquic Vertic Paleustalfs
McLennan	Fine-silty, carbonatic, thermic Udic Ustochrepts
Minwells	Fine, mixed, thermic Udic Paleustalfs
Oglesby	Clayey, montmorillonitic, thermic Lithic Haplustolls
Ovan	Fine, montmorillonitic, thermic Udic Haplusterts
Payne	Fine, montmorillonitic, thermic Udic Paleustalfs
Purves	Clayey, montmorillonitic, thermic Lithic Calciustolls
Queeny	Loamy, mixed, thermic, shallow Petrocalcic Calciustolls
Real	Loamy-skeletal, carbonatic, thermic, shallow Typic Calciustolls
Riesel	Clayey-skeletal, mixed, thermic Udic Paleustalfs
San Saba	Fine, montmorillonitic, thermic Leptic Udic Haplusterts
Sanger	Fine, montmorillonitic, thermic Udic Haplusterts
Ships	Very fine, mixed, thermic Chromic Hapluderts
Slidell	Fine, montmorillonitic, thermic Udic Haplusterts
Stephen	Clayey, mixed, thermic, shallow Udorthentic Haplustolls
Styx	Loamy, siliceous, thermic Arenic Paleustalfs
Sunev	Fine-loamy, carbonatic, thermic Udic Calciustolls
Tinn	Fine, montmorillonitic, thermic Typic Hapluderts
Weswood	Fine-silty, mixed, thermic Fluventic Ustochrepts
Wilson	Fine, montmorillonitic, thermic Oxyaquic Vertic Haplustalfs
Yahola	Coarse-loamy, mixed (calcareous), thermic Udic Ustifluvents

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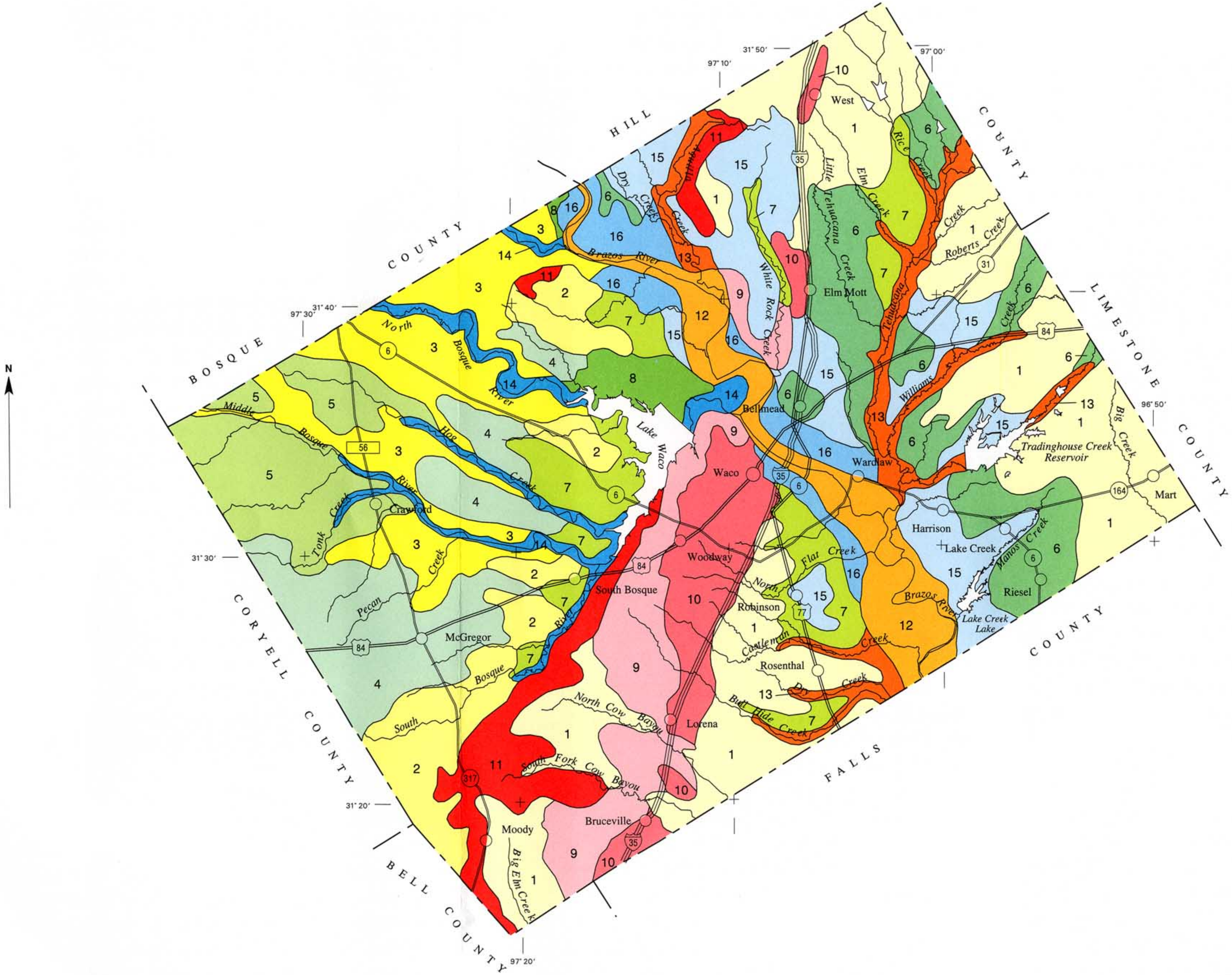


Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SOIL LEGEND*

CLAYEY SOILS FORMED IN RESIDUMM DERIVED FROM SHALE AND MARL; ON UPLANDS

1	Heiden - Houston Black - Ferris
2	Slidell - Sanger

LOAMY AND CLAYEY SOILS FORMED MAINLY IN RESIDUMM DERIVED FROM LIMESTONE; ON UPLANDS

3	Aledo - Eckrant
4	Crawford - Purves
5	Bolar - Denton

LOAMY AND CLAYEY SOILS FORMED IN ALLUVIAL SEDIMENTS ALONG LOCAL STREAMS; ON UPLANDS AND PLEISTOCENE-AGE TERRACES

6	Wilson - Bremond - Mabank
7	Branyon - Burleson
8	Payne

LOAMY AND CLAYEY SOILS FORMED IN RESIDUMM DERIVED FROM CHALK AND MARL; ON UPLANDS

9	Eddy - Stephen
10	Fairlie - Austin
11	Lott - McLennan

LOAMY AND CLAYEY SOILS FORMED IN ALLUVIUM; ON FLOOD PLAINS

12	Weswood - Yahola - Ships
13	Tinn - Ovan
14	Frio - Bosque

SANDY AND LOAMY SOILS FORMED IN ALLUVIAL SEDIMENTS ALONG THE BRAZOS RIVER; ON STREAM TERRACES AND PLEISTOCENE-AGE TERRACES

15	Axtell - Riesel - Minwells
16	Bastsil - Desan - Gholson

*The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1992

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

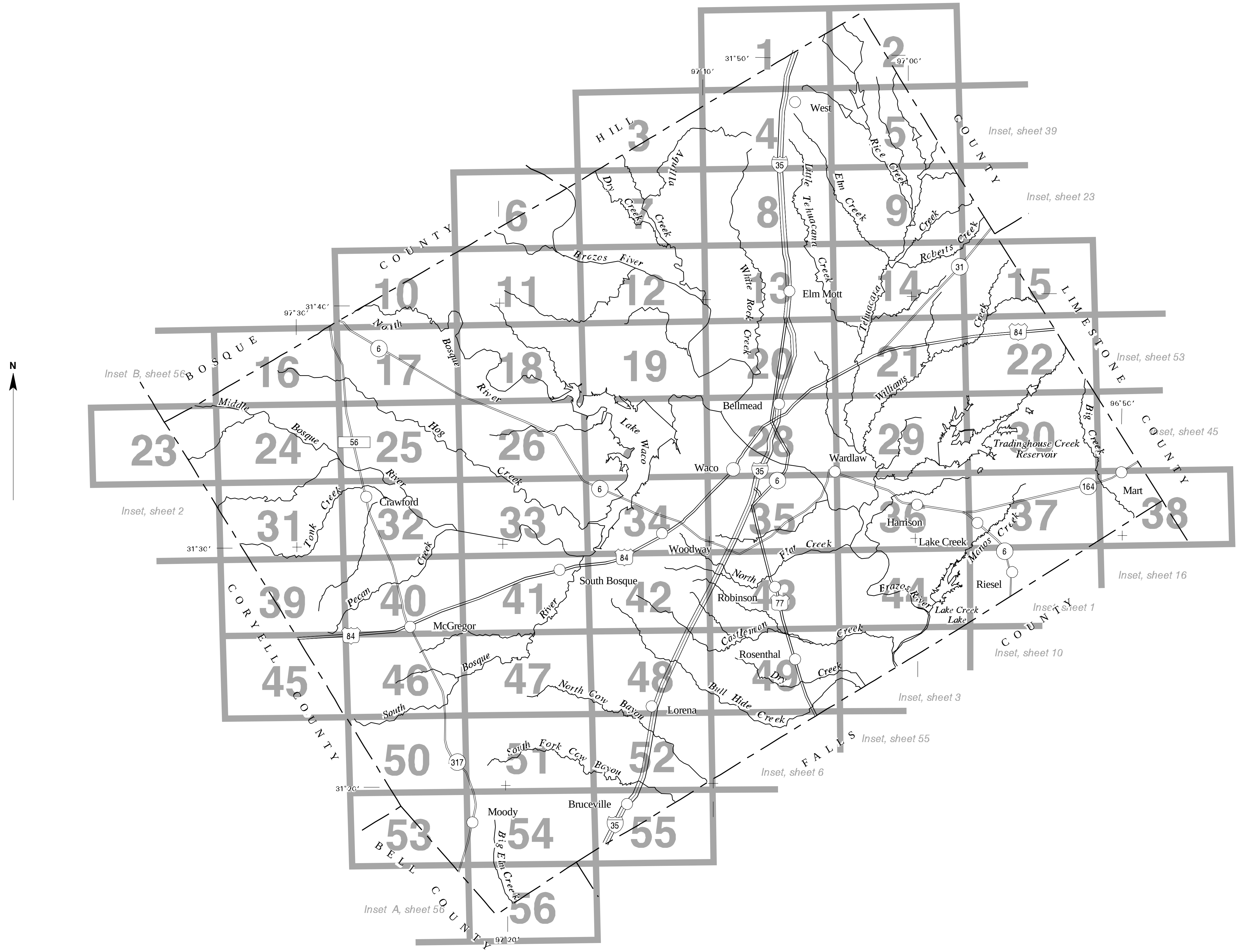
GENERAL SOIL MAP

MCLENNAN COUNTY, TEXAS

Scale 1:316800

1 0 1 2 3
MILES

1 0 1 2 3 4 5 6
KILOMETERS



INDEX TO MAP SHEETS

MCLENNAN COUNTY, TEXAS

Scale 1:316800

1 0 1 2 3

MILES

1 0 1 2 3 4 5 6

KILOMETERS

SOIL LEGEND

Soil map publication symbols and map unit names are listed alphabetically. The first letter is always a capital and is the initial letter of the soil name. The second letter is a lowercase letter. The third letter, if used, is a capital and denotes slope class. Symbols without the third letter are for nearly level soils or for miscellaneous areas. A final number of 2 indicates the soil is eroded.

SYMBOL	NAME
AdC	Aledo gravelly clay loam, 2 to 5 percent slopes
AdE	Aledo-Brackett complex, 5 to 20 percent slopes
AsB	Austin silty clay, 1 to 3 percent slopes
AuC	Austin-Urban land complex, 1 to 3 percent slopes
AxB	Axtell fine sandy loam, 1 to 3 percent slopes
BaA	Bastsil fine sandy loam, 0 to 2 percent slopes
BaB	Bastsil-Urban land complex, 0 to 2 percent slopes
BgB	Bolar gravelly clay loam, 1 to 3 percent slopes
Bh	Bosque clay loam, occasionally flooded
BnA	Branyon clay, 0 to 1 percent slopes
BnB	Branyon clay, 1 to 3 percent slopes
BrB	Bremond loam, 0 to 2 percent slopes
BuA	Burleson clay, 0 to 1 percent slopes
CaB	Chazos loamy fine sand, 1 to 3 percent slopes
CfB	Crawford clay, 0 to 2 percent slopes
CrB	Crockett loam, 3 to 5 percent slopes
DeB	Denton silty clay, 1 to 3 percent slopes
DsC	Desan loamy fine sand, 1 to 5 percent slopes
DuB	Dutek loamy fine sand, 1 to 3 percent slopes
EcB	Eckrant cobbly silty clay, 1 to 3 percent slopes
EdD	Eddy gravelly clay loam, 3 to 15 percent slopes
EeD	Eddy-Urban land complex, 3 to 15 percent slopes
EsE	Ellis clay, 8 to 20 percent slopes
FaB	Fairlie clay, 1 to 3 percent slopes
FbB	Fairlie-Urban land complex, 1 to 3 percent slopes
FeE2	Ferris clay, 8 to 15 percent slopes, eroded
Fr	Frio silty clay, occasionally flooded
Ga	Gaddy loamy fine sand, frequently flooded
GhD	Gholson fine sandy loam, 3 to 8 percent slopes
Go	Gowen clay loam, frequently flooded
HeB	Heiden clay, 1 to 3 percent slopes
HeC	Heiden clay, 3 to 5 percent slopes
HeD	Heiden clay, 5 to 8 percent slopes
HgB	Heiden gravelly clay, 1 to 3 percent slopes
HoB	Houston Black clay, 1 to 3 percent slopes
KrC	Krum silty clay, 2 to 5 percent slopes

SYMBOL	NAME
LaD	Lamar clay loam, 3 to 8 percent slopes
LeB	Lewisville silty clay, 1 to 3 percent slopes
LoB	Lott silty clay, 1 to 5 percent slopes
LoD	Lott silty clay, 5 to 8 percent slopes
MaA	Mabank fine sandy loam, 0 to 1 percent slopes
MbA	Mabank-Bremond complex, 0 to 1 percent slopes
McE	McLennan clay loam, 8 to 15 percent slopes
MnB	Minwells fine sandy loam, 1 to 3 percent slopes
MnC2	Minwells fine sandy loam, 3 to 5 percent slopes, eroded
OgB	Oglesby silty clay, 1 to 3 percent slopes
Ov	Ovan silty clay, frequently flooded
PcB	Payne clay loam, 1 to 3 percent slopes
Pg	Pits, gravel
Pr	Pits, quarry
PvB	Purves clay, 1 to 3 percent slopes
QuC	Queeny clay loam, 1 to 5 percent slopes
ReF	Real-Rock outcrop complex, 10 to 30 percent slopes
RgB	Riesel gravelly fine sandy loam, 1 to 3 percent slopes
SaB	San Saba clay, 0 to 2 percent slopes
SgB	Sanger clay, 1 to 3 percent slopes
Sh	Ships clay, rarely flooded
SsB	Slidell clay, 0 to 2 percent slopes
StC	Stephen-Eddy complex, 2 to 5 percent slopes
SuD	Stephen-Urban land complex, 2 to 5 percent slopes
SyB	Styx loamy fine sand, 1 to 3 percent slopes
SzB	Sunev clay loam, 1 to 3 percent slopes
Tn	Tinn clay, rarely flooded
To	Tinn clay, frequently flooded
Ur	Urban land
Wd	Weswood silt loam, rarely flooded
We	Weswood silty clay loam, rarely flooded
WnA	Wilson clay loam,0 to 2 percent slopes
Ya	Yahola loam, rarely flooded
Yg	Yahola-Gaddy complex, occasionally flooded

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK
1 890 000 FEET

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small (Named where applicable)

PITS

- Gravel pit
- Mine or quarry

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

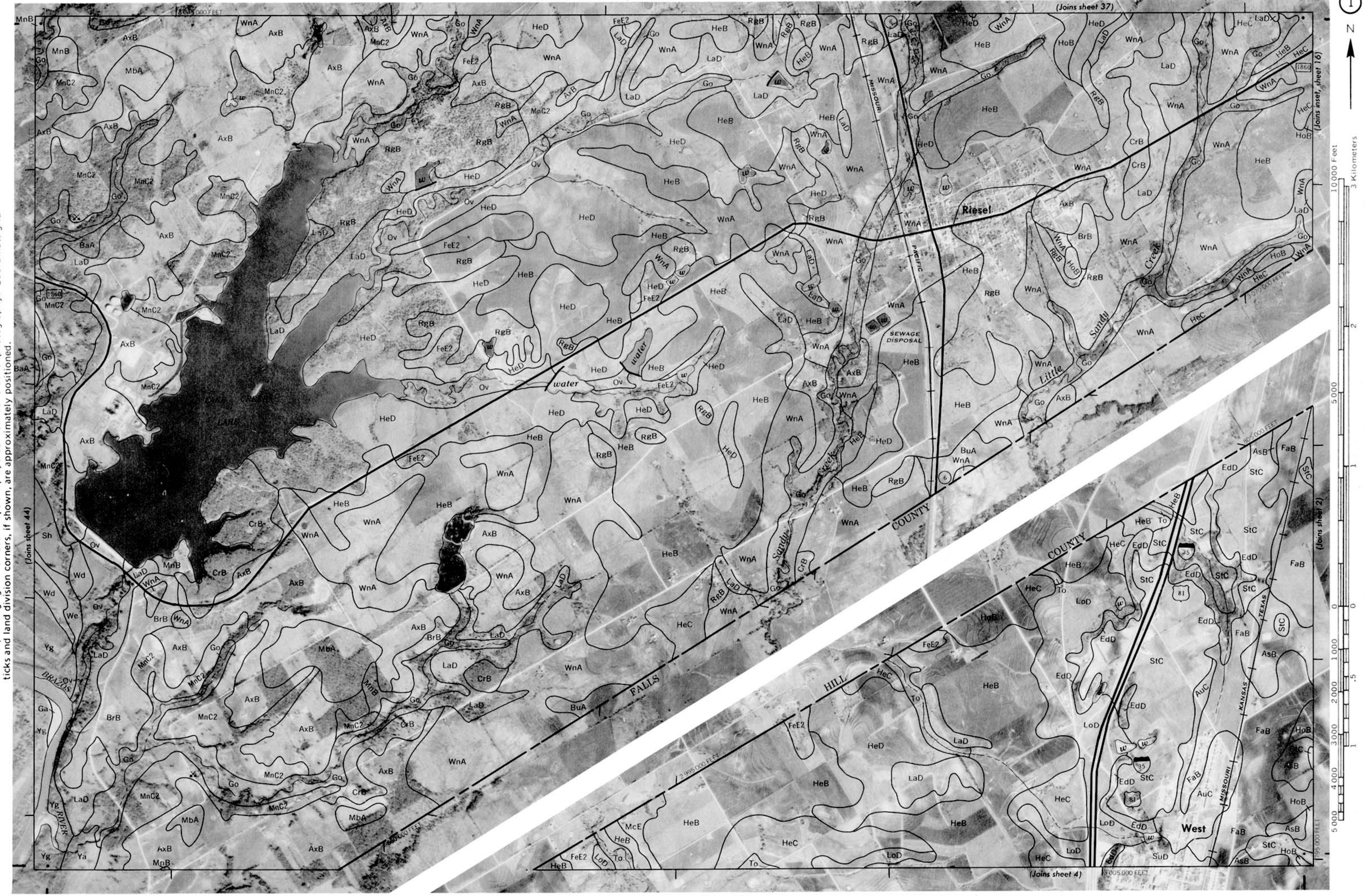
ESCARPMENTS

- Bedrock (points down slope)

SOIL SAMPLE (normally not shown)

MISCELLANEOUS

- Gravelly spot
- Severely eroded spot



This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1979 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MCLENNAN COUNTY, TEXAS — SHEET NUMBER 2

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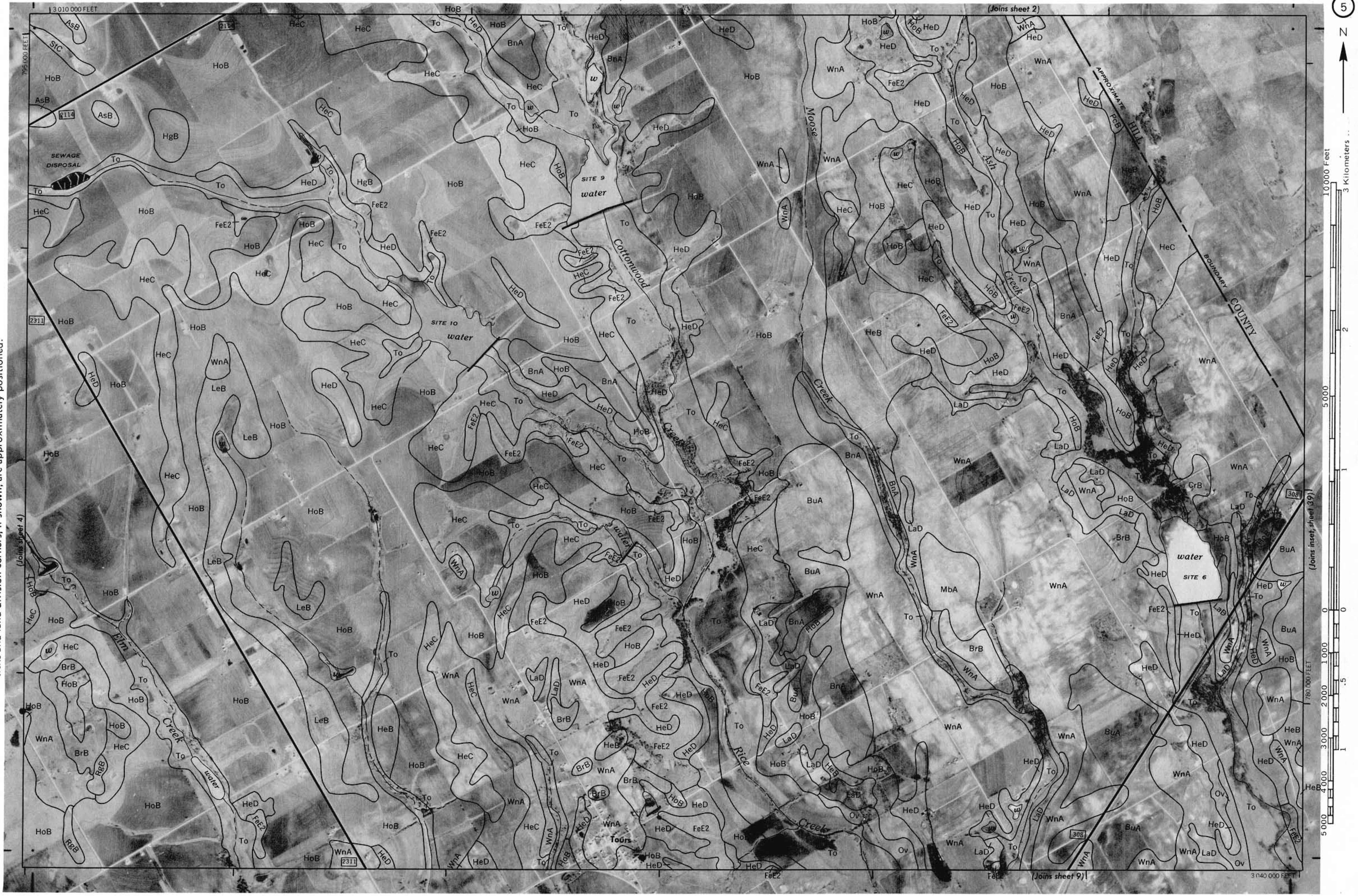
5



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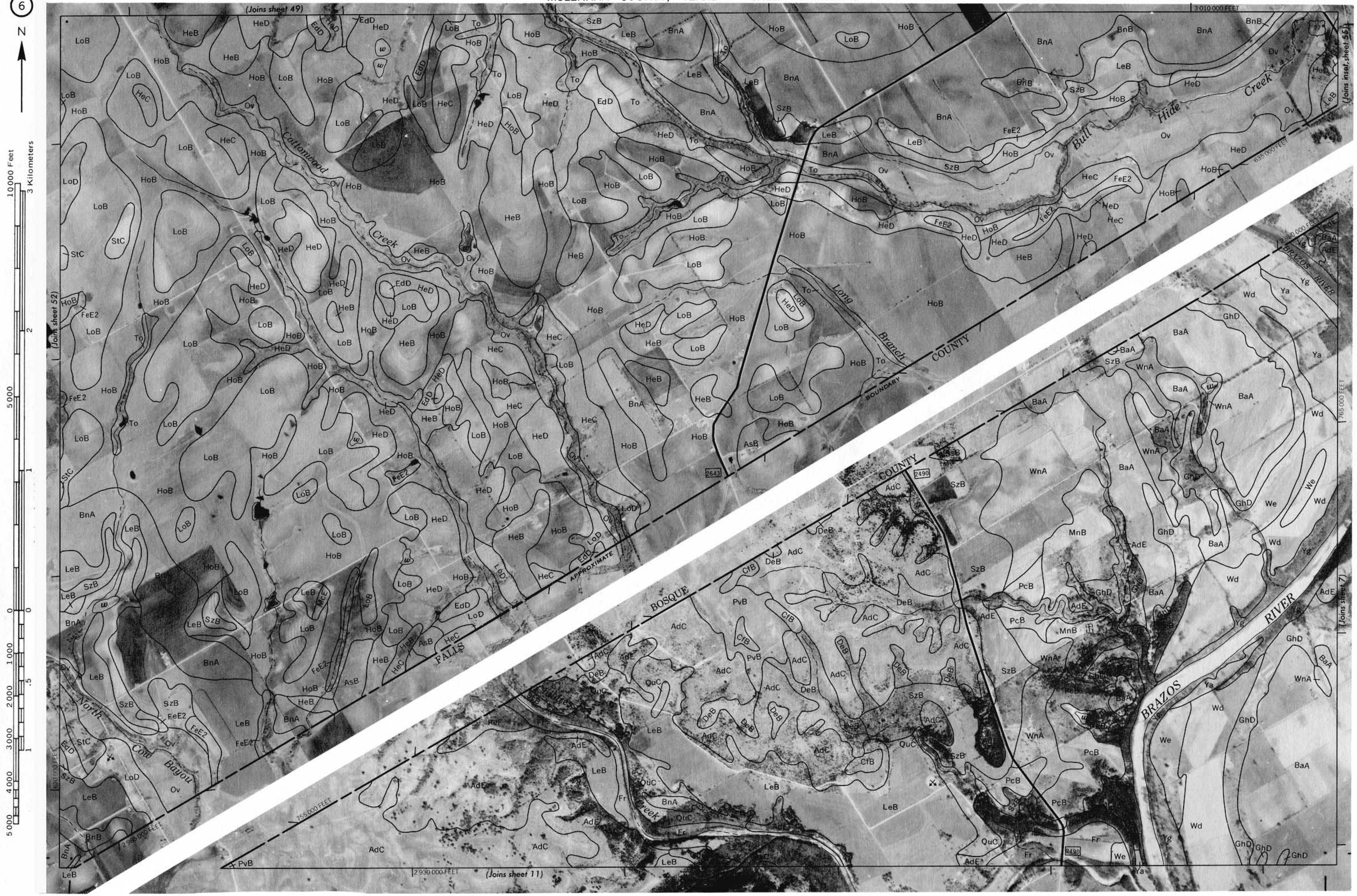

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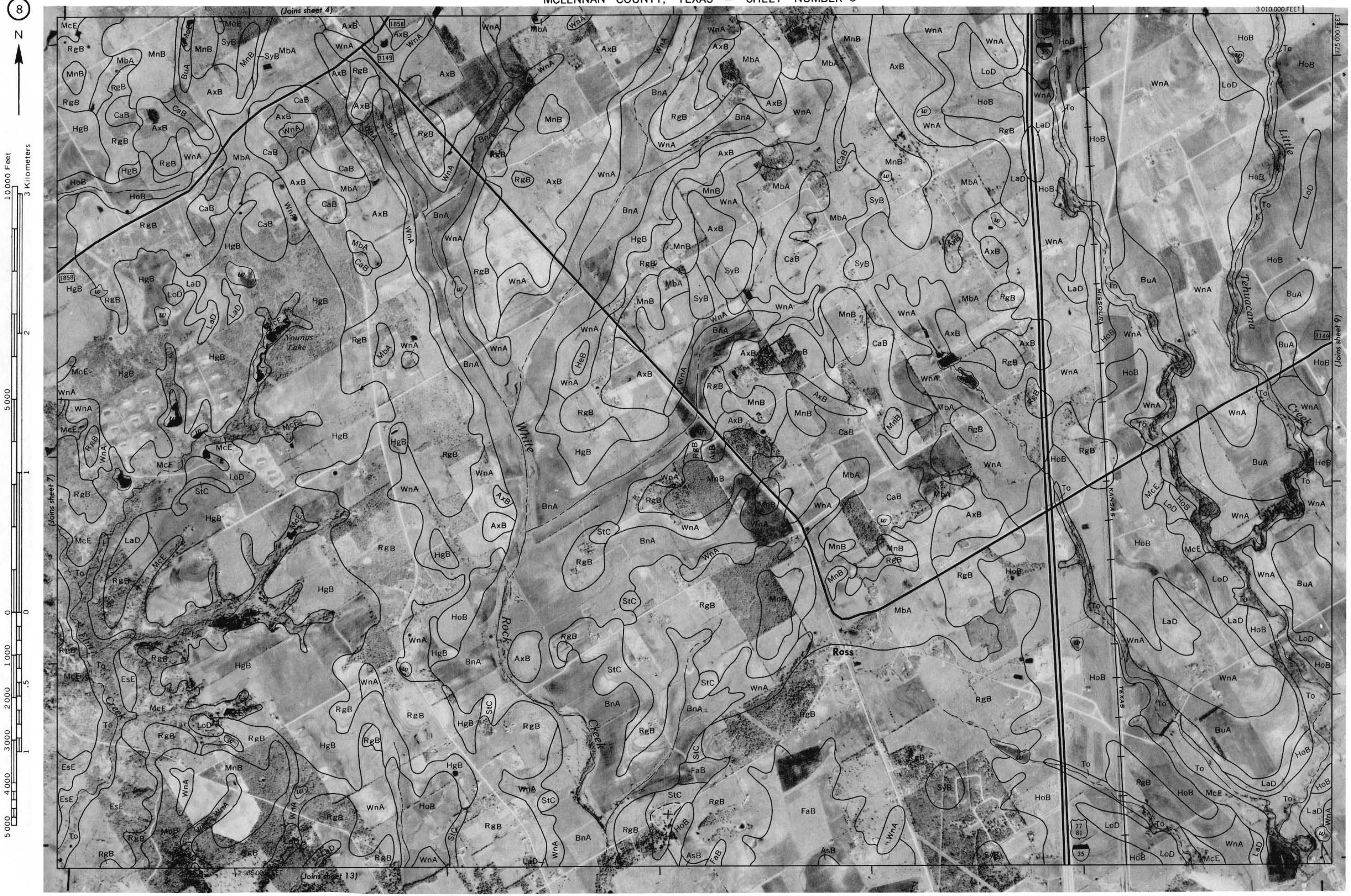

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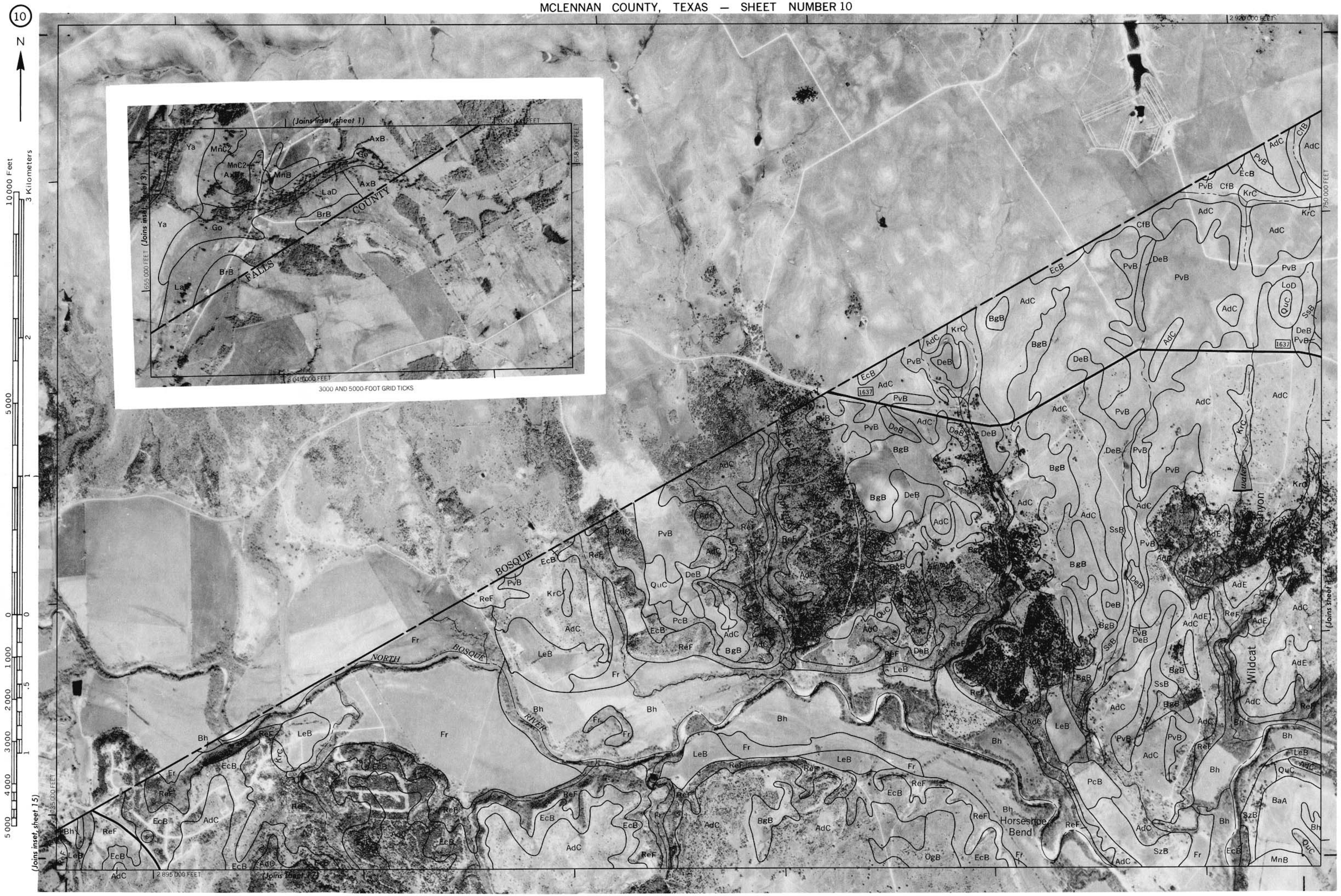

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N

10000 Feet
3 Kilometers

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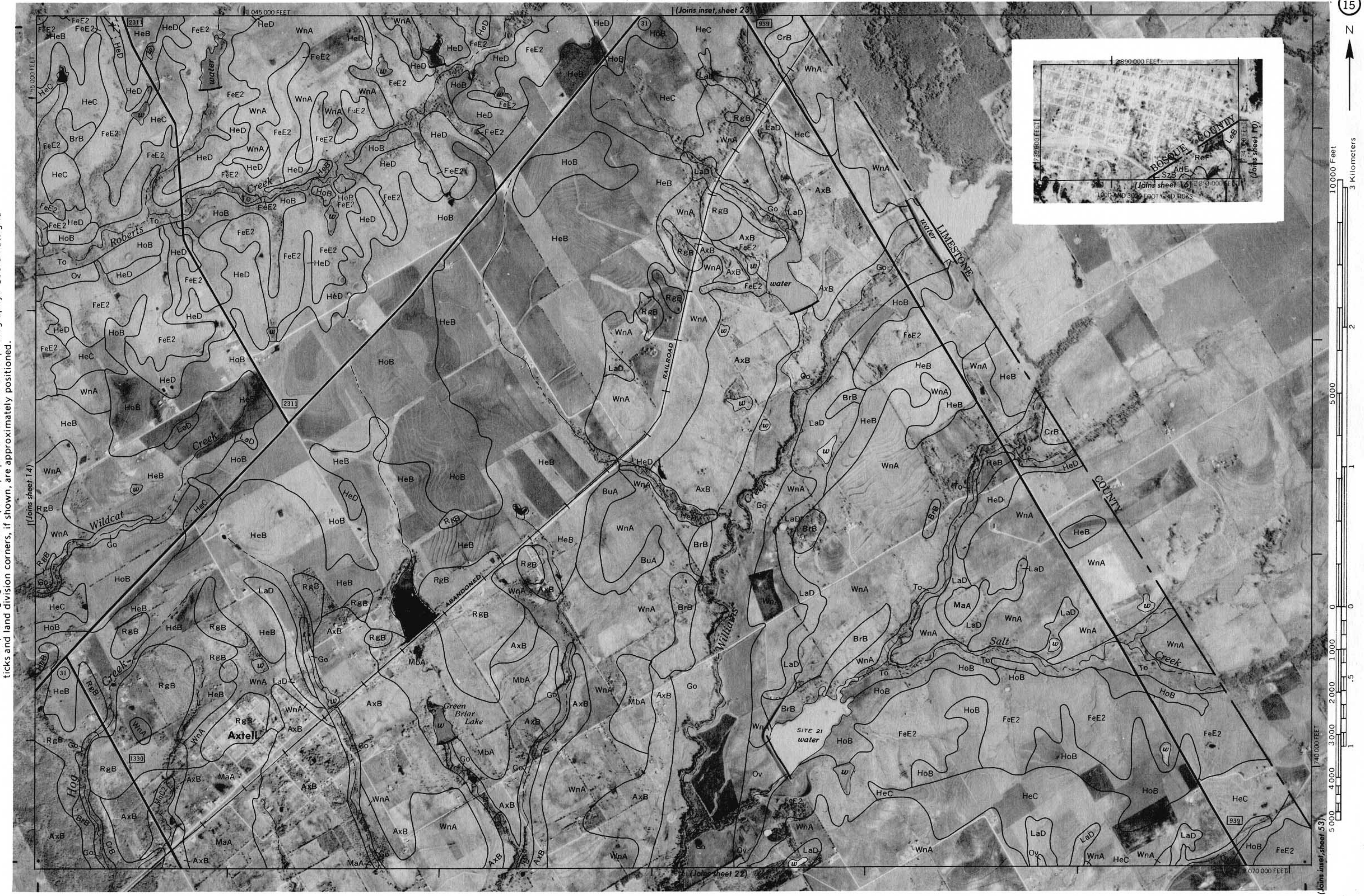
15



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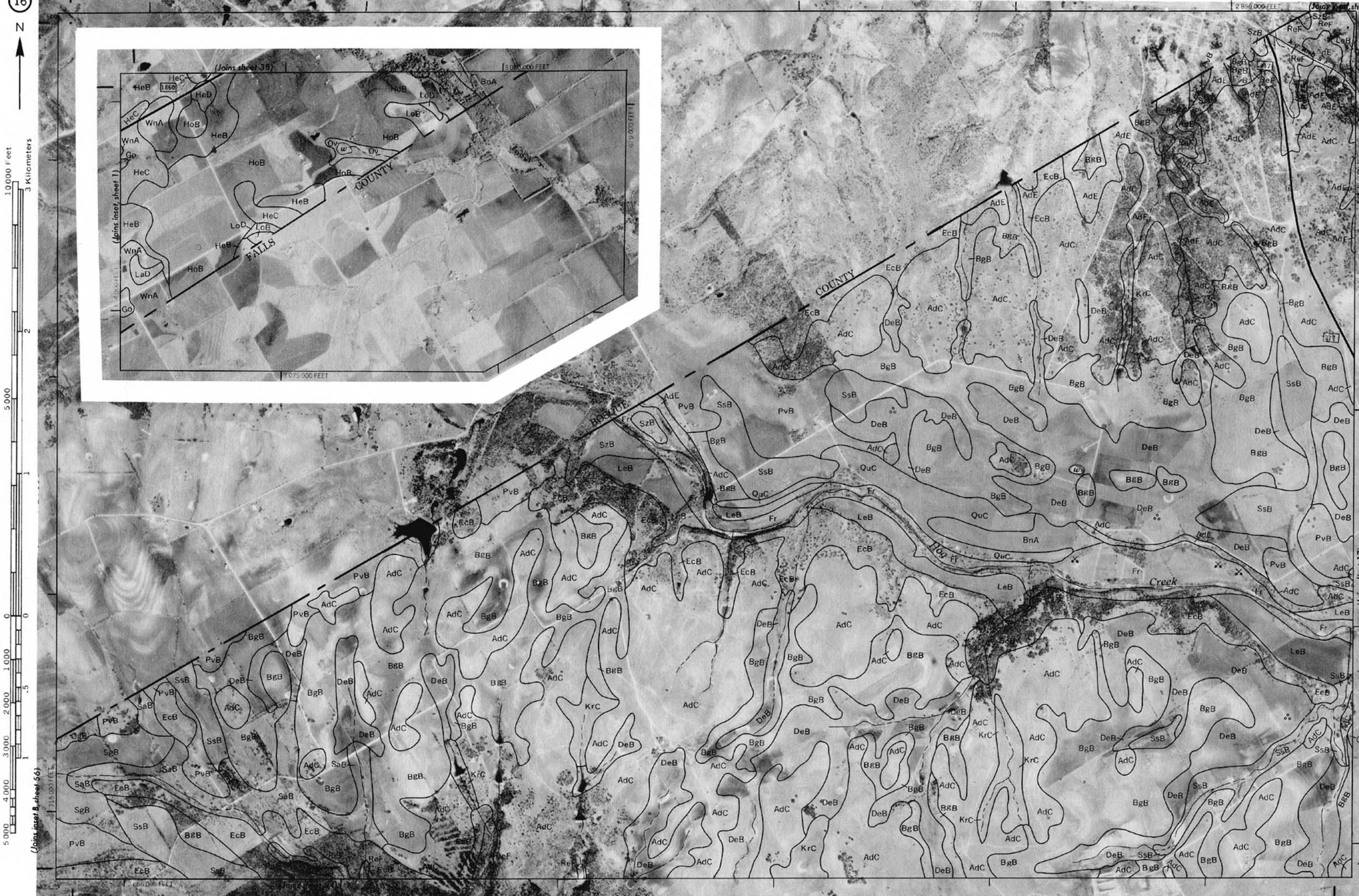

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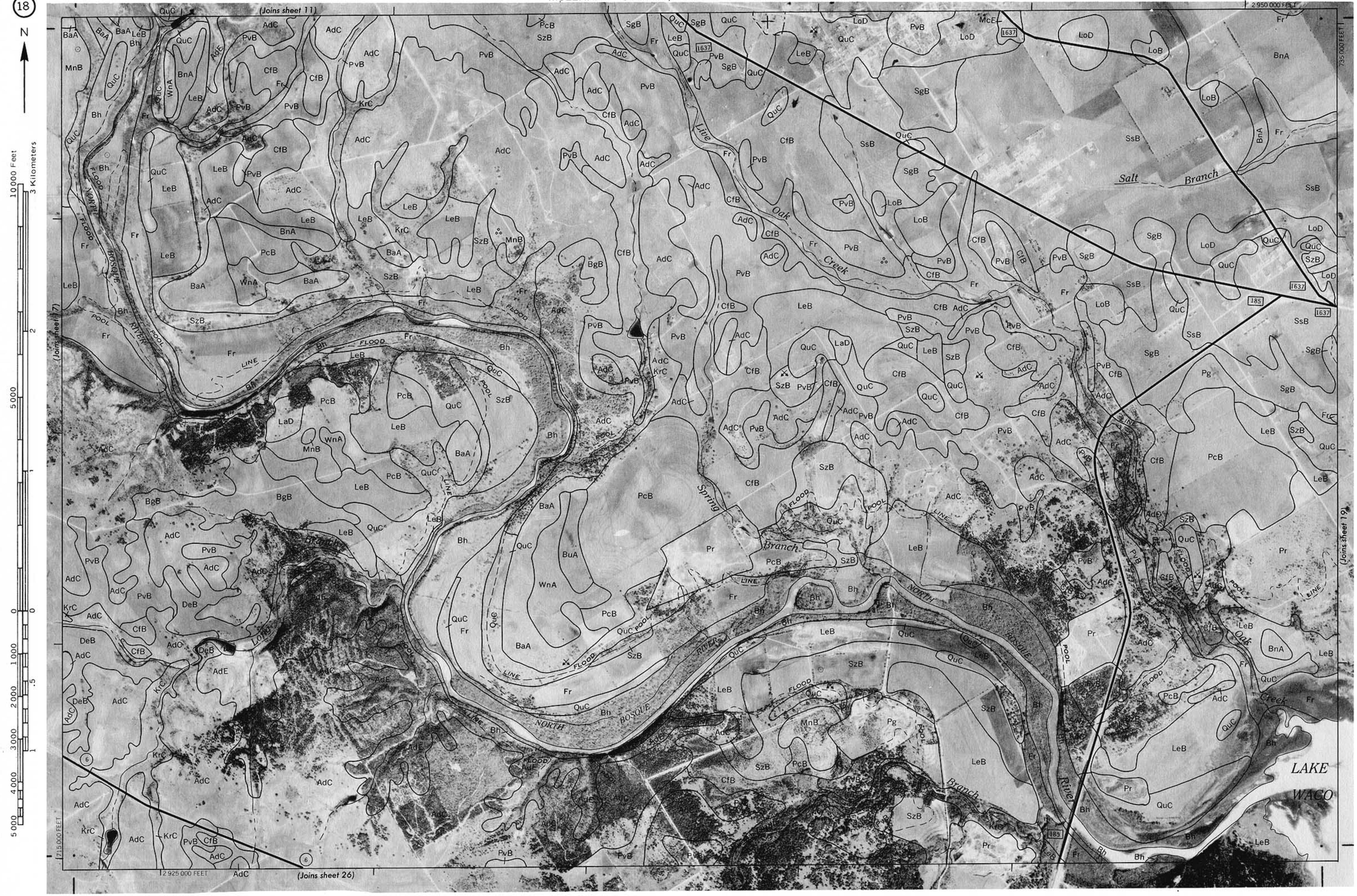
MCLENNAN COUNTY, TEXAS — SHEET NUMBER 18



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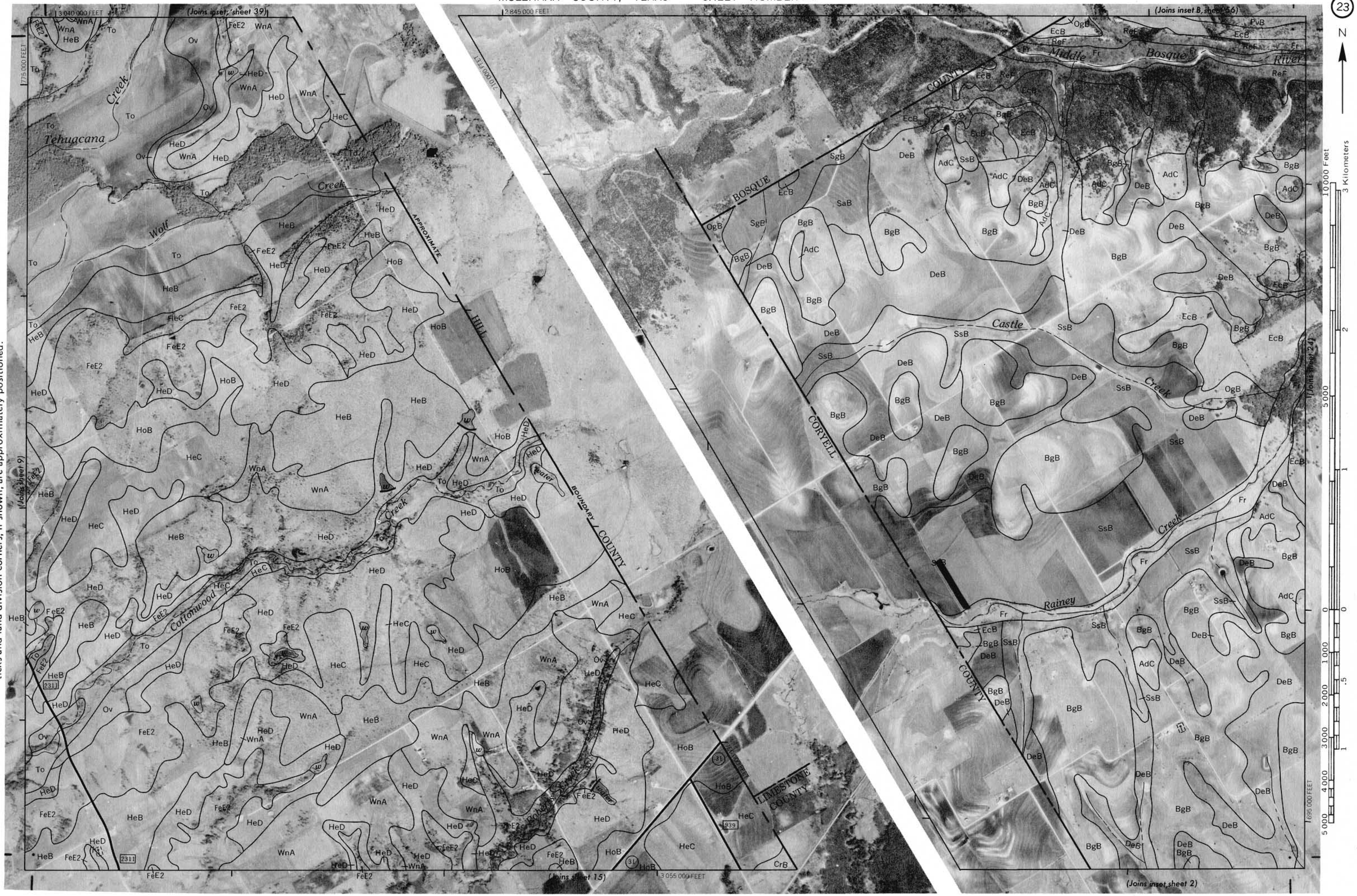

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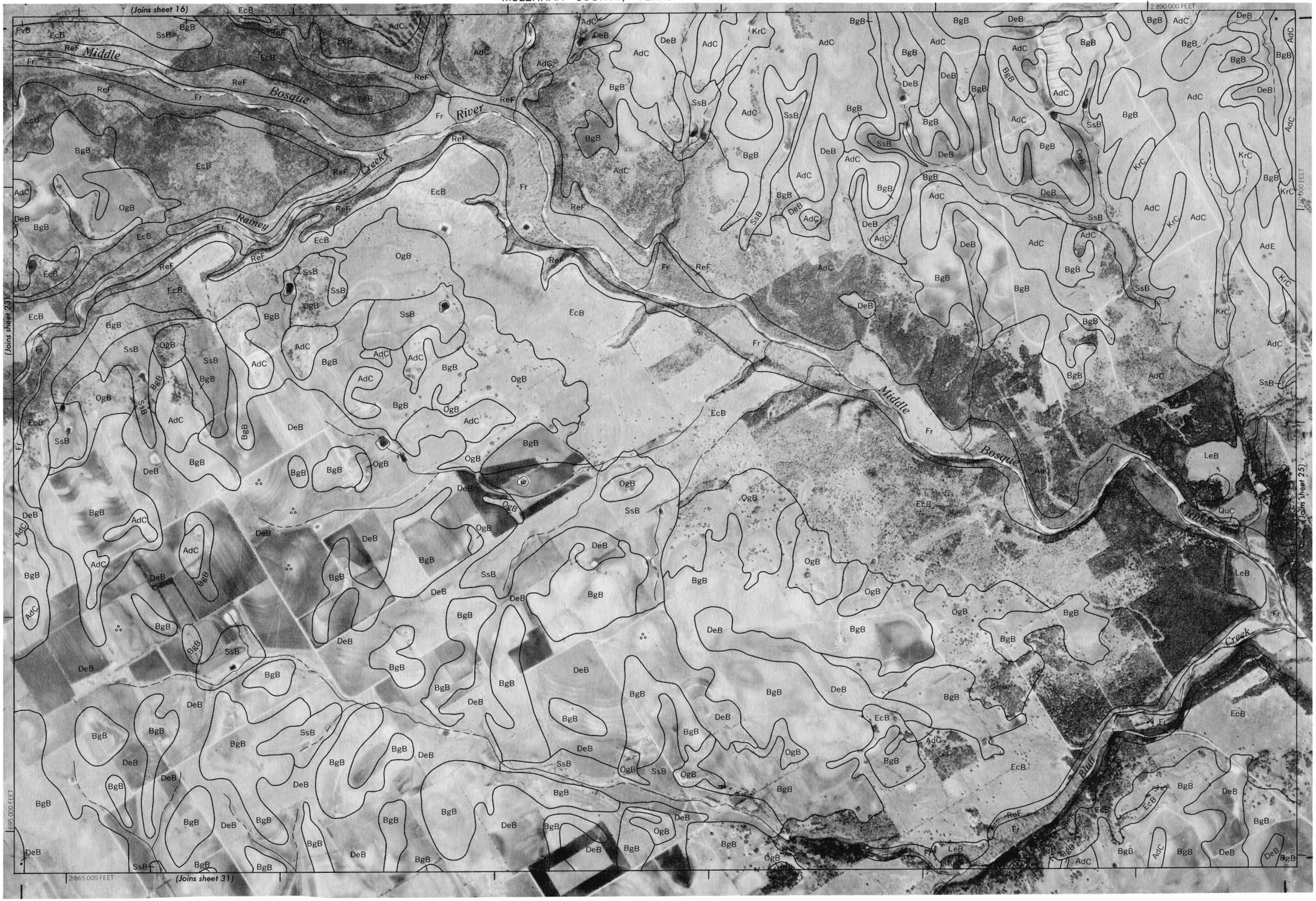
MCLENNAN COUNTY, TEXAS — SHEET NUMBER 24

N

10 000 Feet

3 Kilometers



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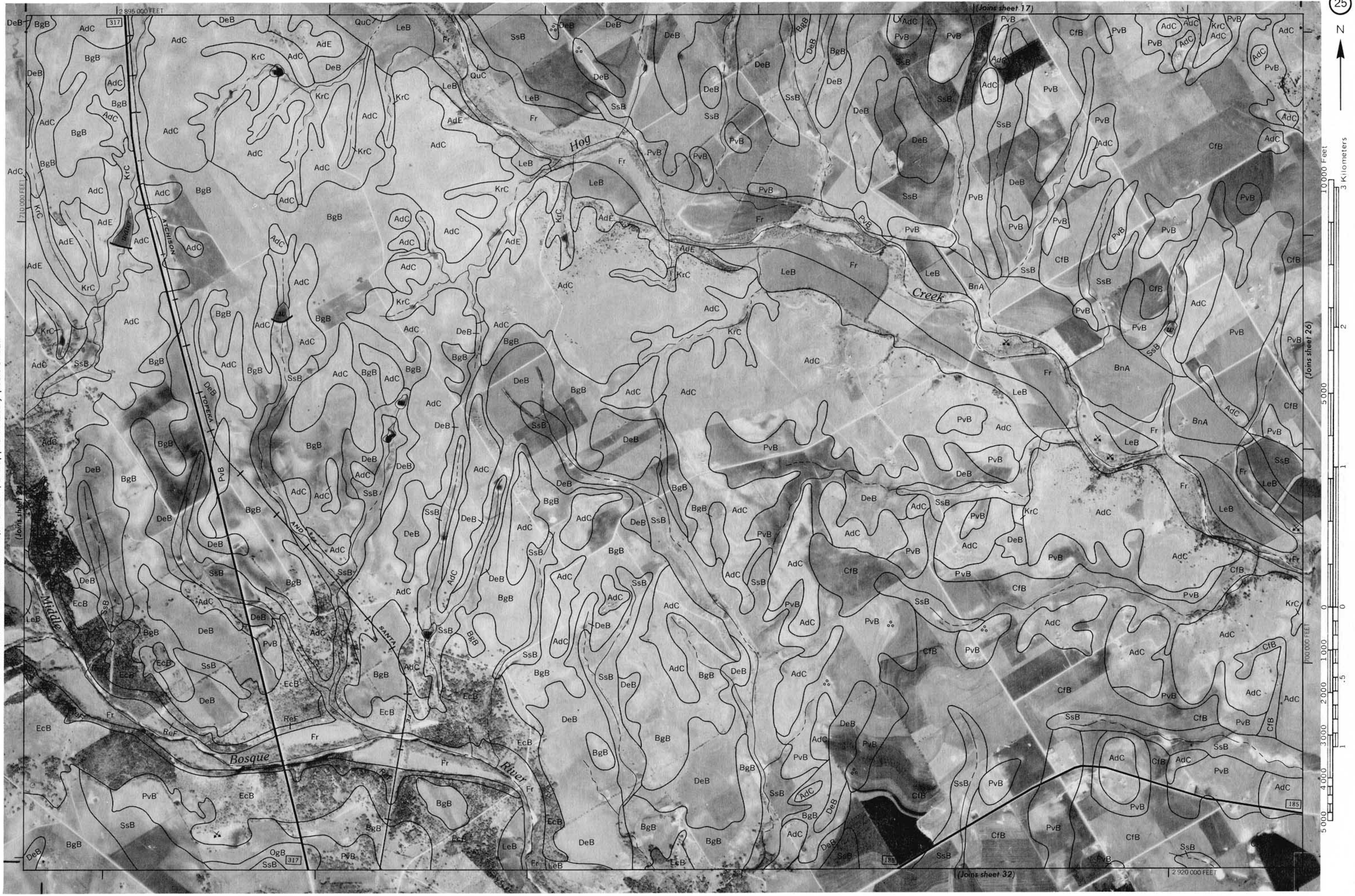

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MCLENNAN COUNTY, TEXAS — SHEET NUMBER 29

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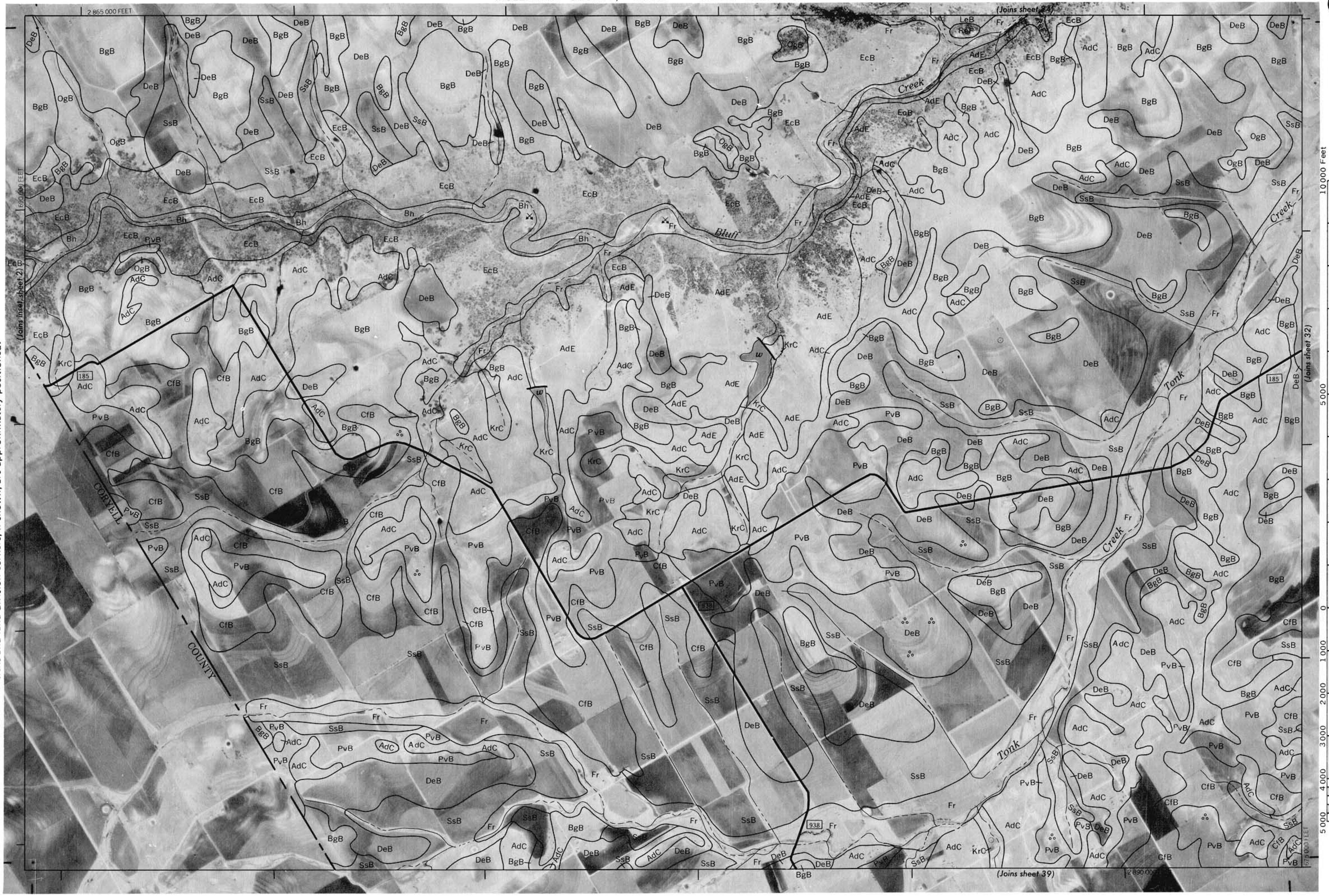
31

N



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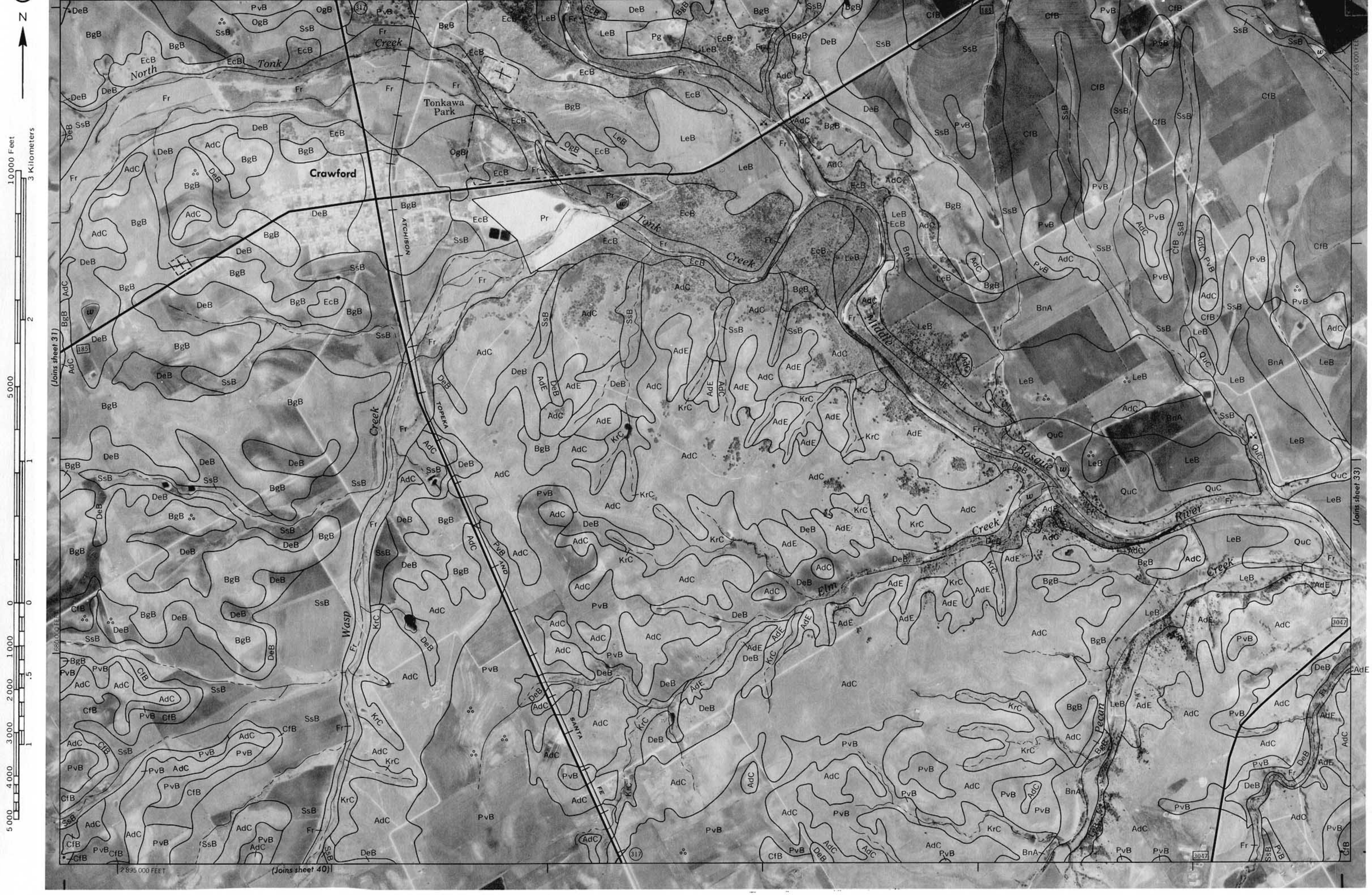
10 000 Feet
3 Kilometers

MCLENNAN COUNTY, TEXAS — SHEET NUMBER 32



This soil survey map was compiled by the U. S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are prepared from 1979 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MCLENNAN COUNTY, TEXAS — SHEET NUMBER 33

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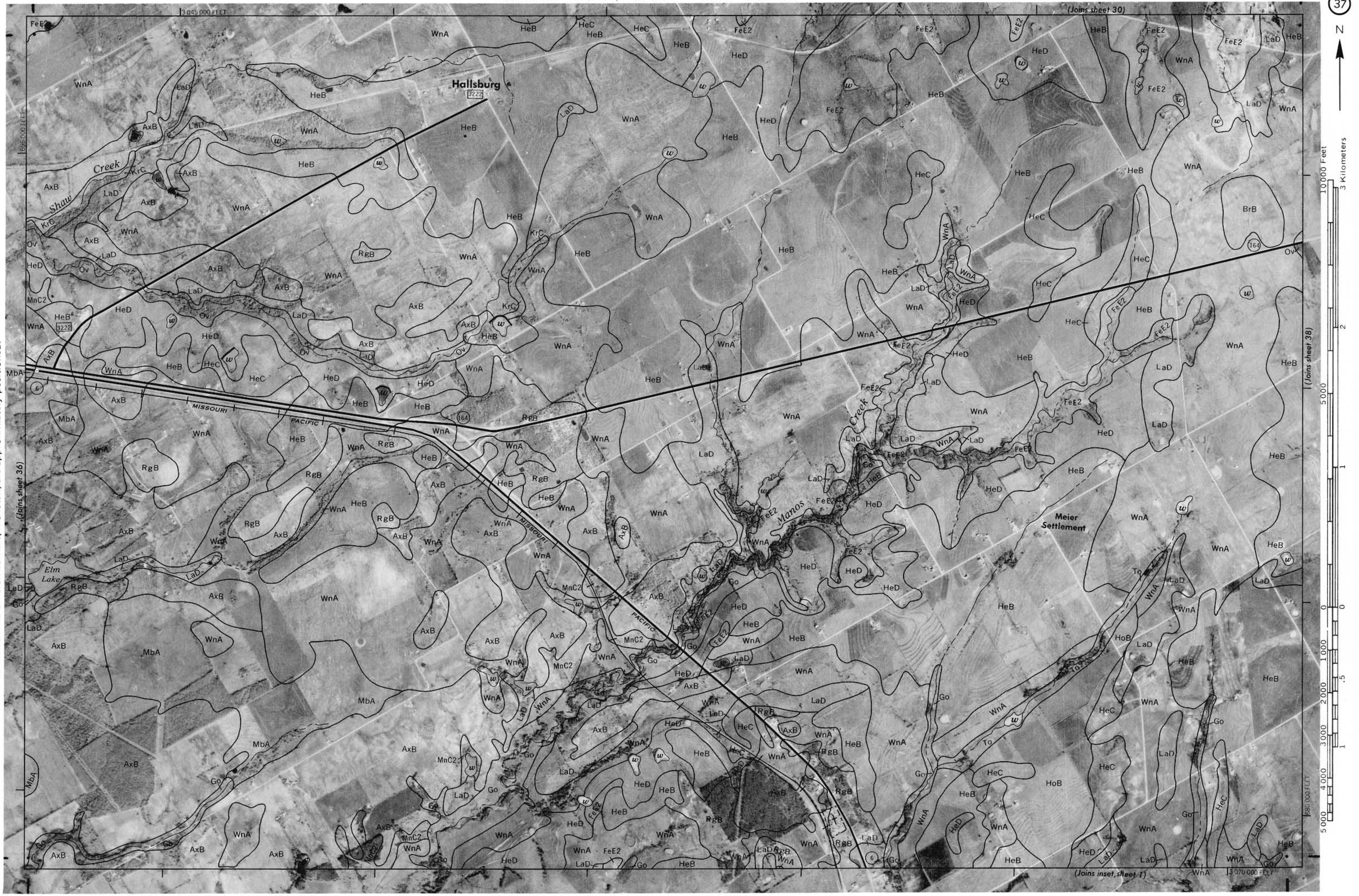

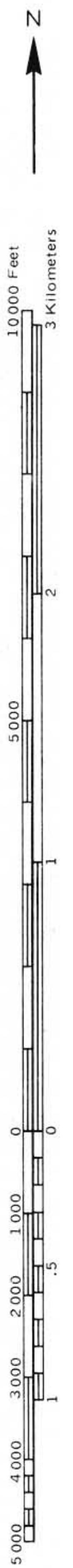

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MCLENNAN COUNTY, TEXAS — SHEET NUMBER 42

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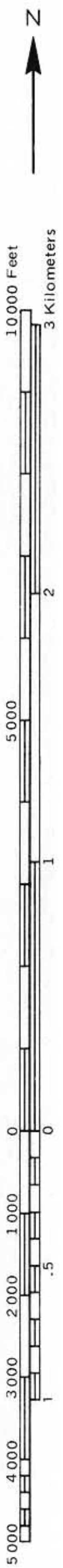

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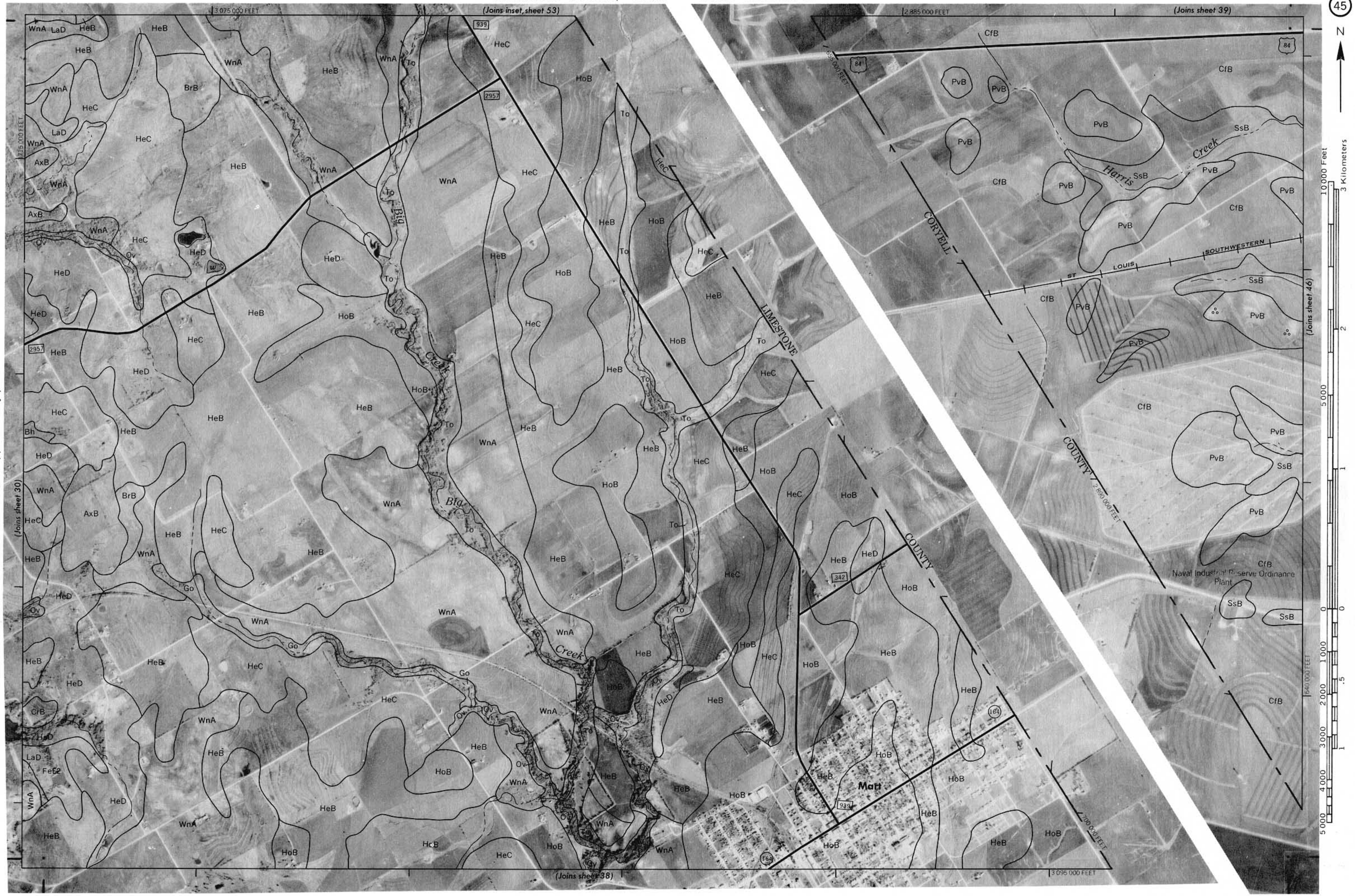

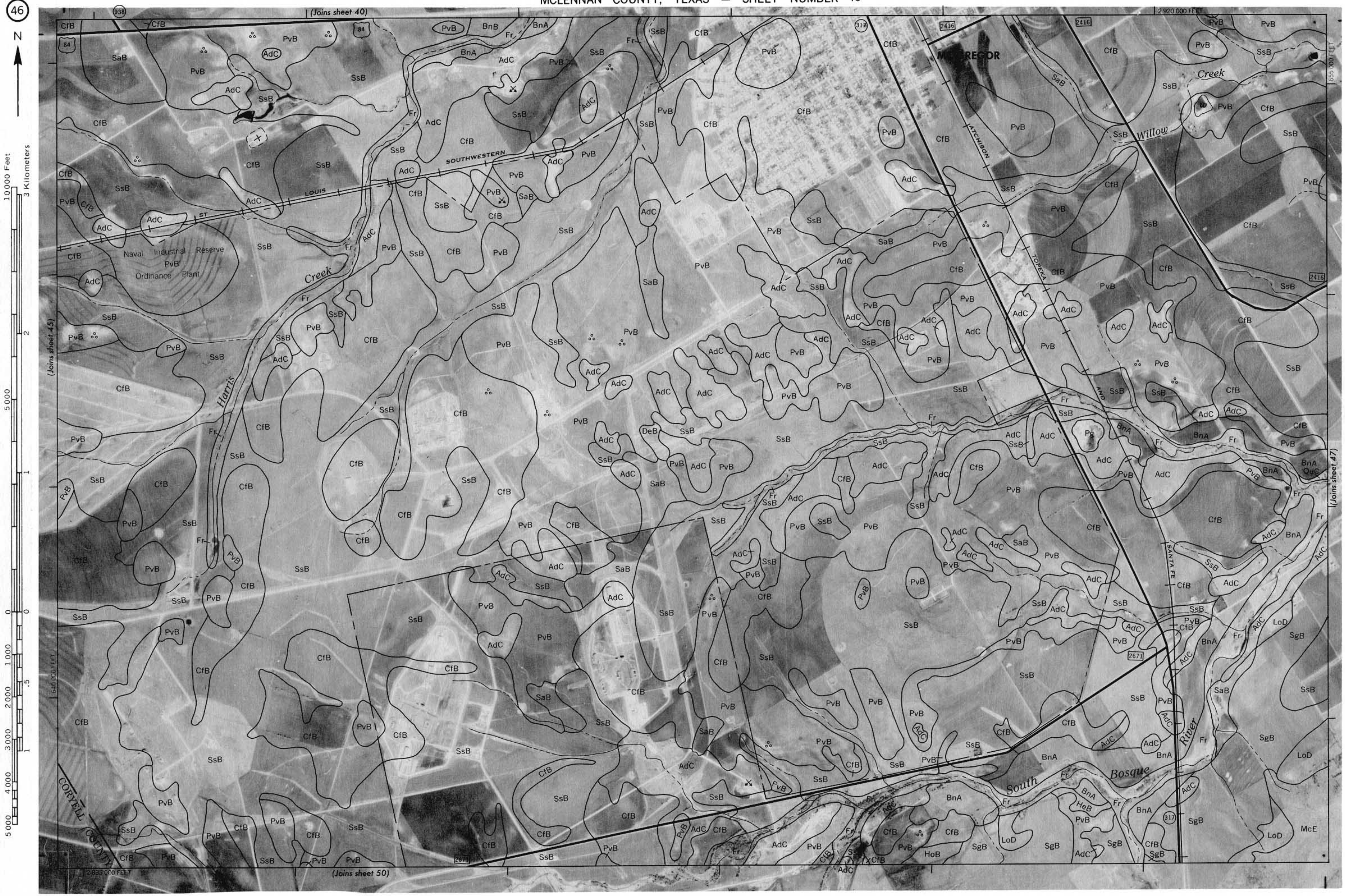

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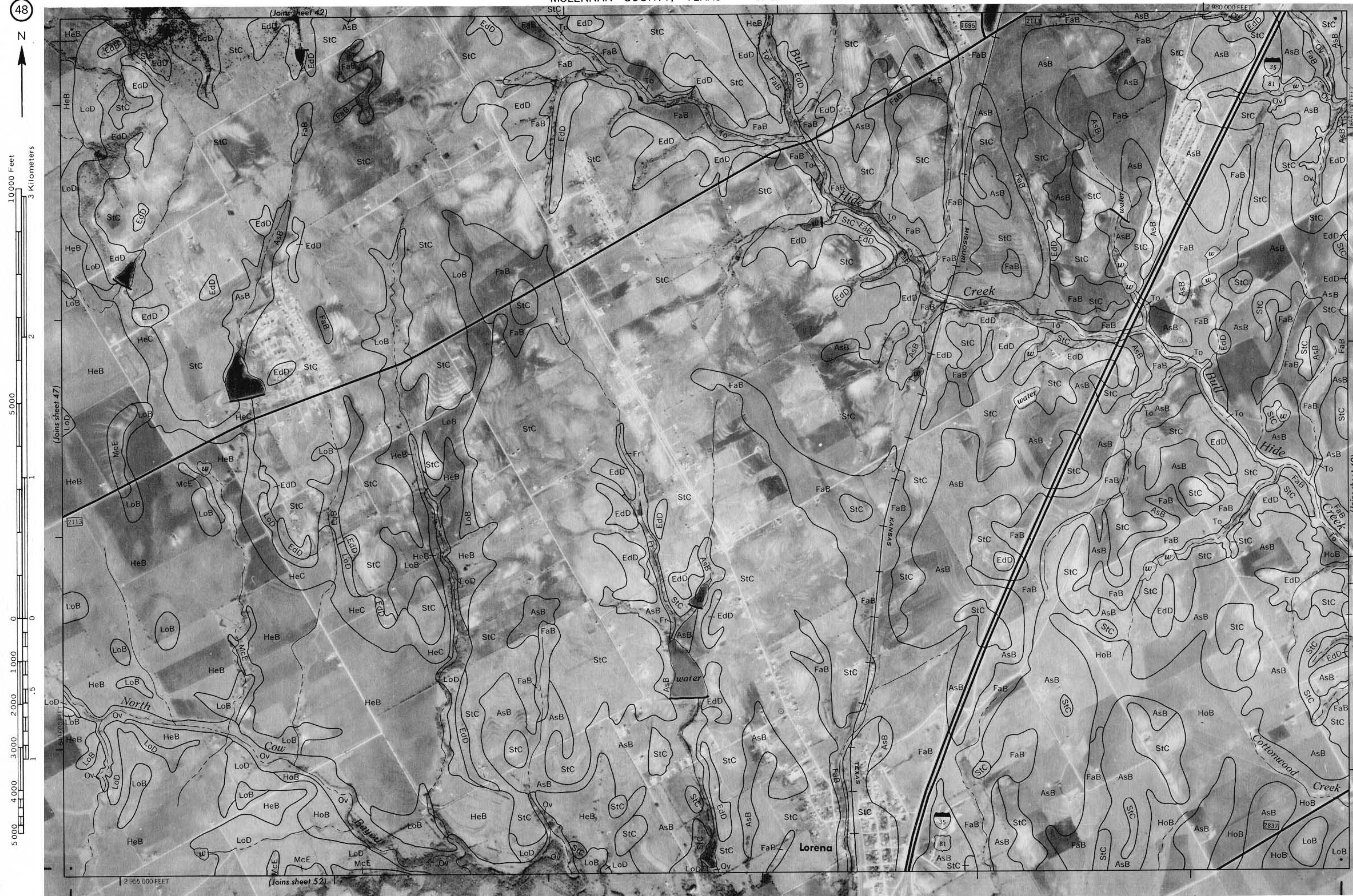
MCLENNAN COUNTY, TEXAS — SHEET NUMBER 48



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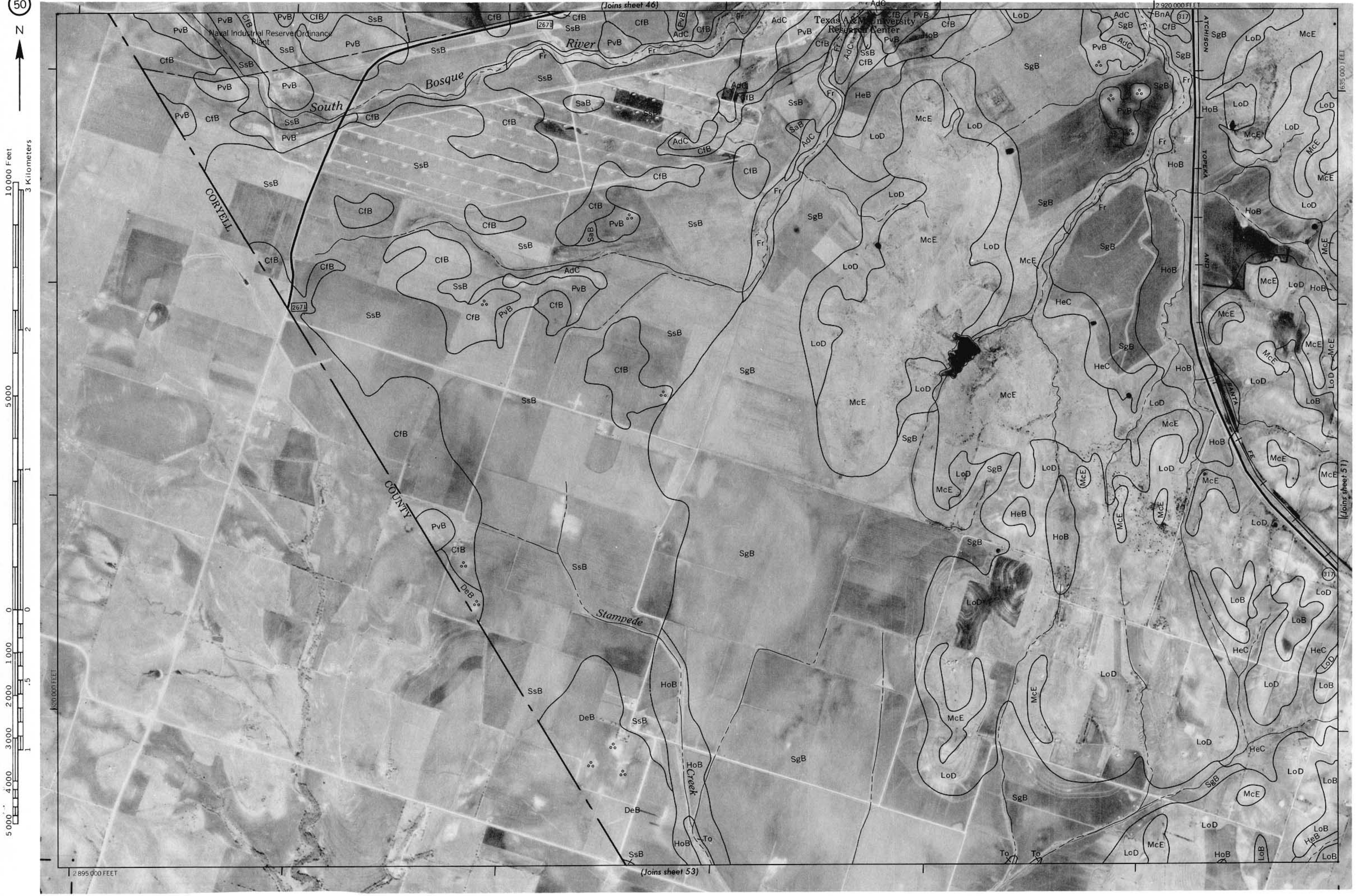

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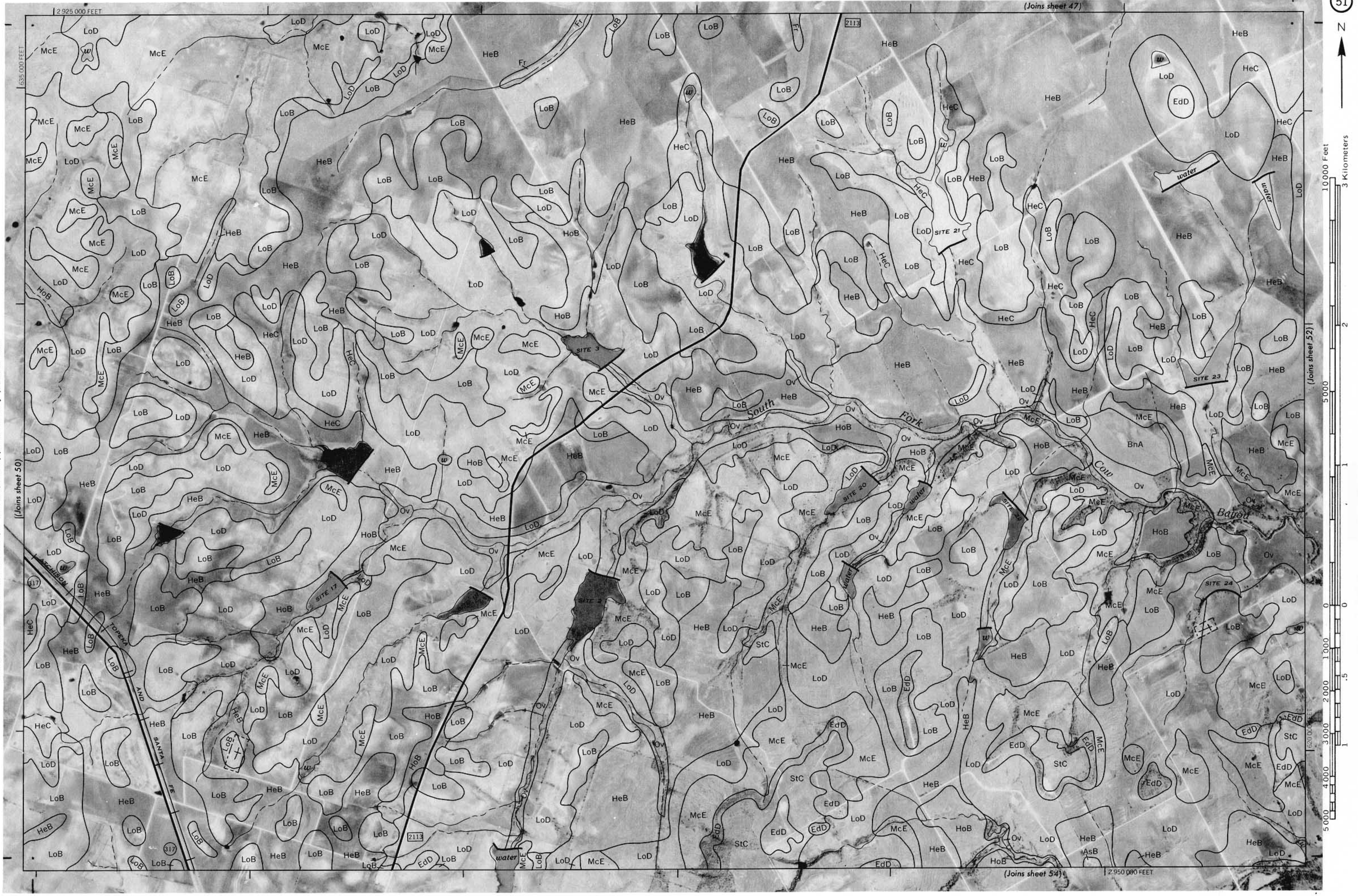

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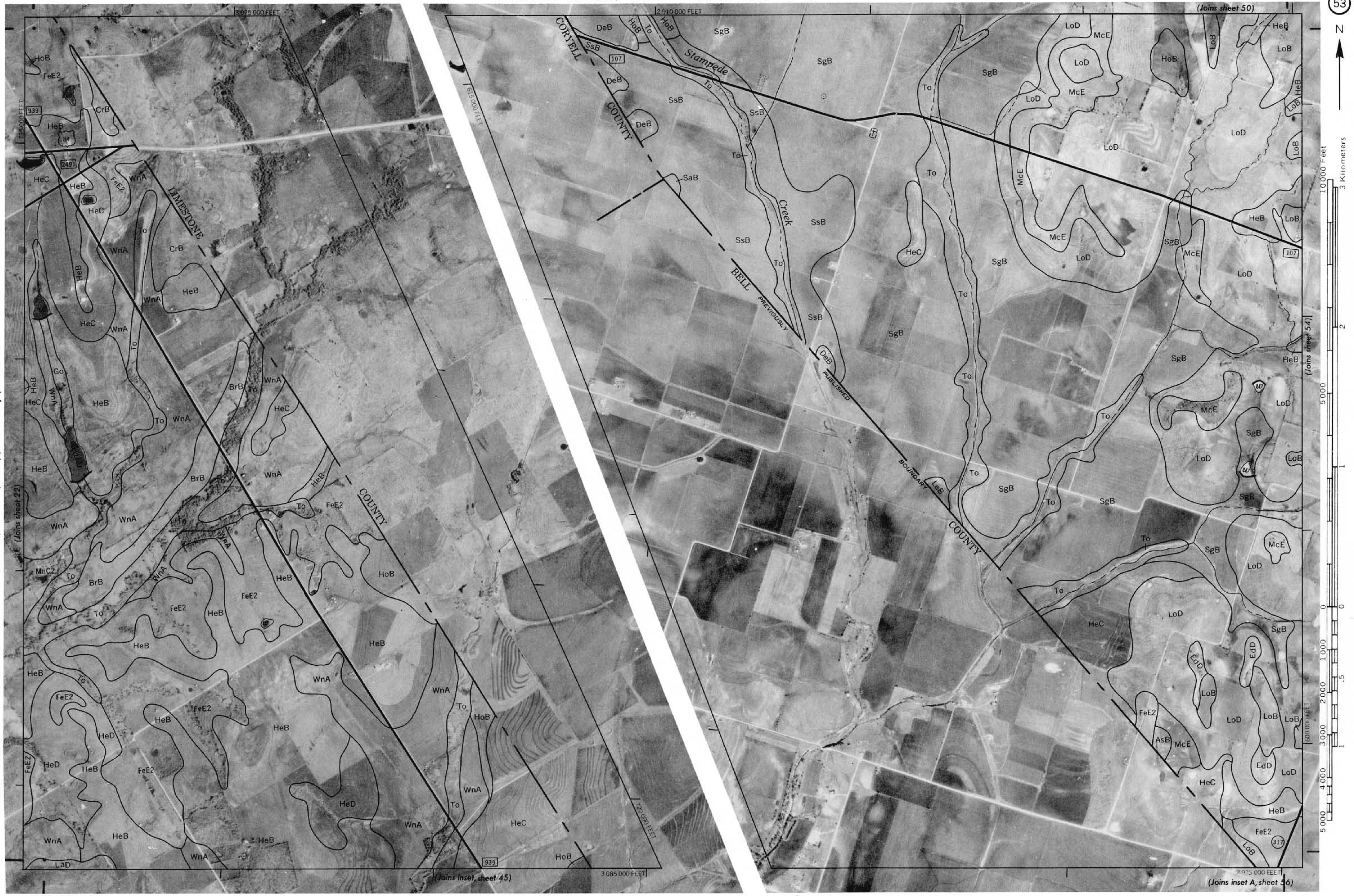

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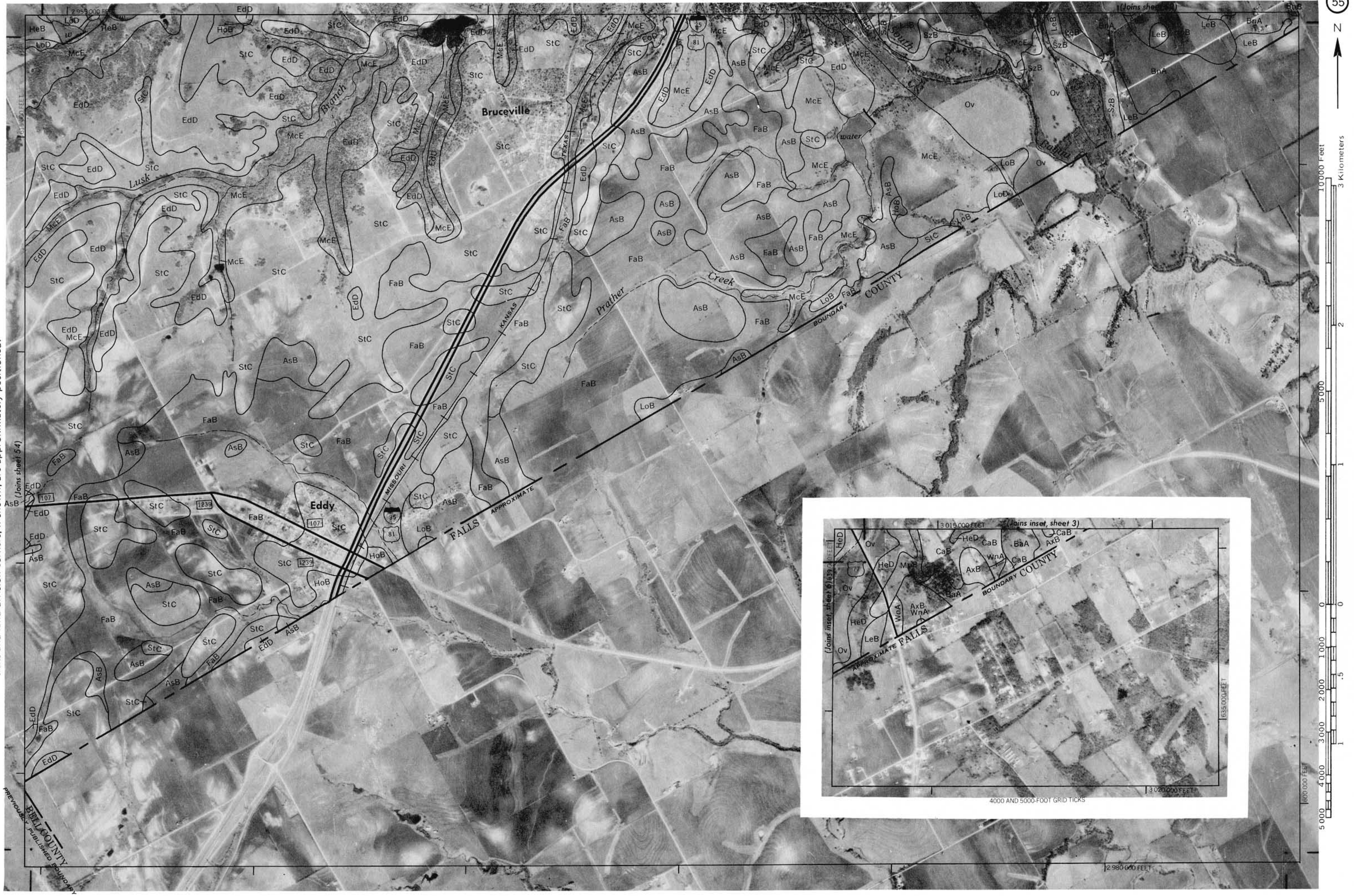

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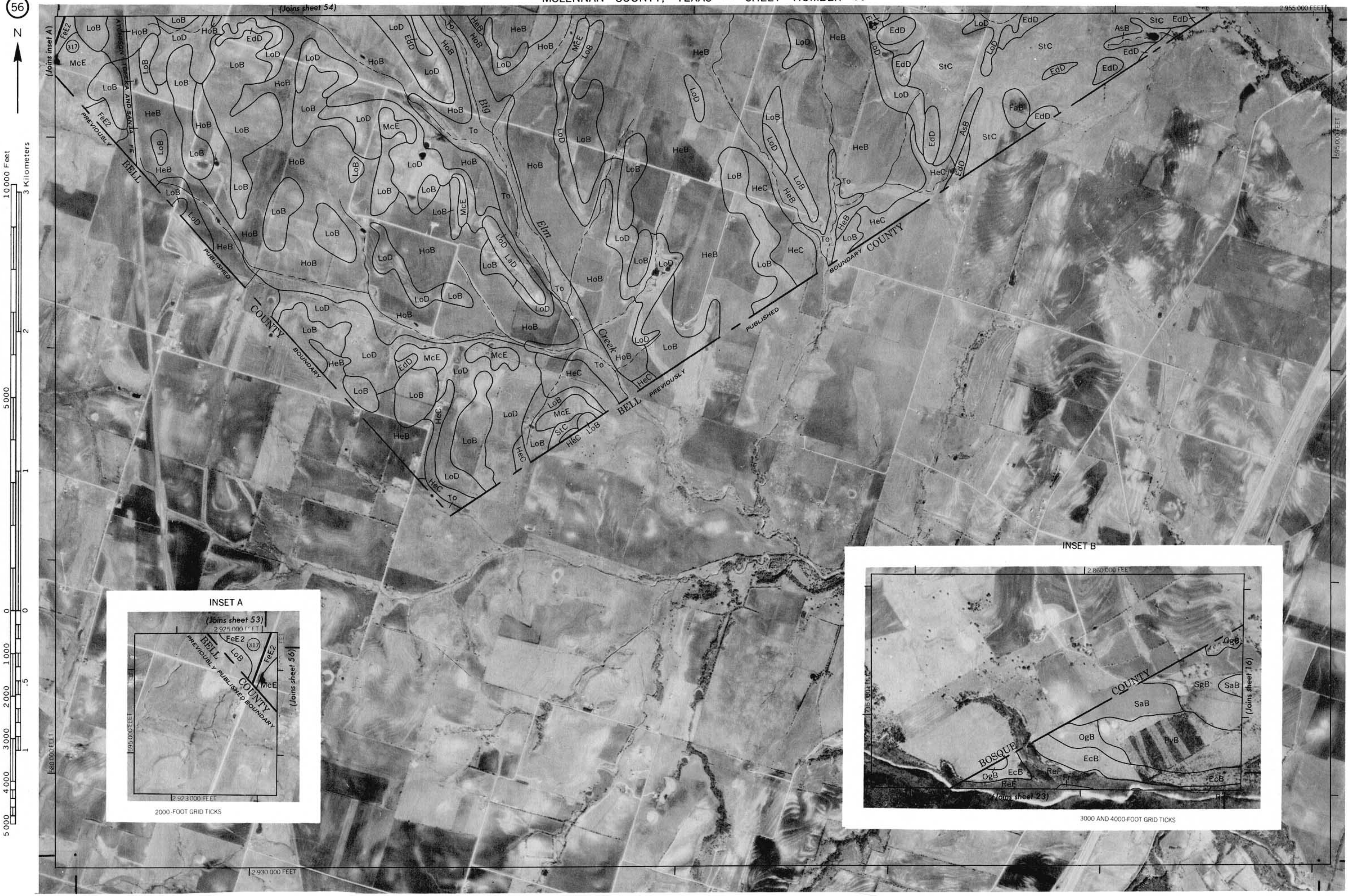

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